Essentials FOR THE Canadian Medical Licensing Exam

Review and Prep for MCCQE PART I

SECOND EDITION

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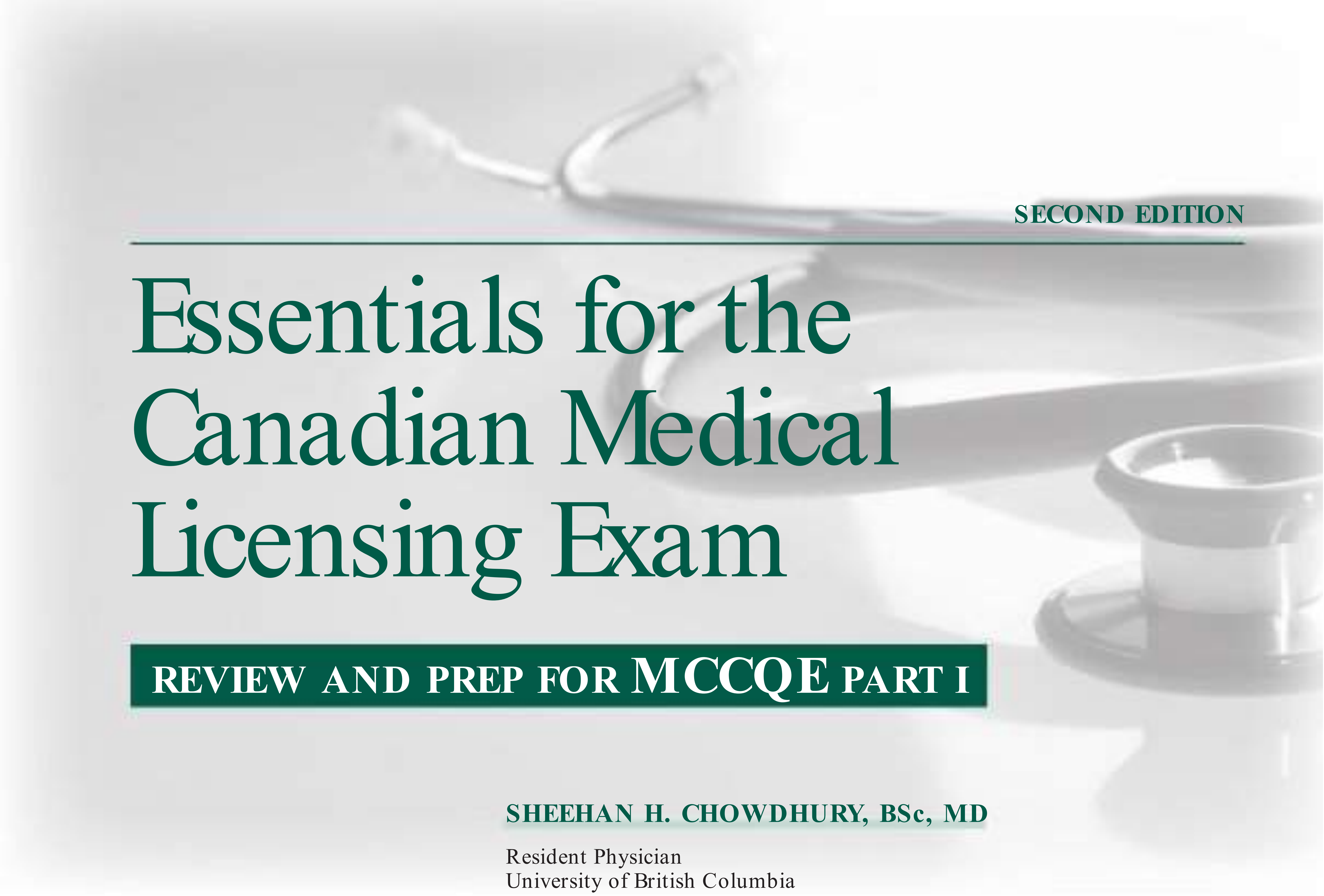
Wolters Kluwer



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REVIEW AND PREP FOR MCCQE PART I

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Dedicated to our loving parents, Tofael and Nadira Chowdhury, and
our brothers, Raiyan and Rezwan.
—Sheehan H. Chowdhury and Jeeshan H. Chowdhury

Dedicated to my parents, Ioan and Natalia Cozma, Alexandra, and
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PREFACE

The Medical Council of Canada Qualifying Examination (MCCQE) Part I is an important milestone for medical students, signifying a culmination of years of training in basic science and clinical medicine. The Medical Council of Canada (MCC) recommends numerous separate texts as reference for this exam preparation. Such a vast reading list is neither a practical nor a feasible means of approaching this critical exam for most candidates. The singular intent of this text is to provide a succinct yet complete review for the MCCQE Part I using the most efficient and effective means.

This book is based entirely on the MCC's *Objectives for the Qualifying Examination, 3rd edition*, which "lay out **exactly what you have to know** for any of the MCC examinations." This text contains only the specific and essential information required to meet the *Objectives*—all extraneous information has been deliberately omitted.

This text avoids time-wasting prose and effusive lists. Information is presented only in concise and easily assimilated visual formats. A focus on tables and flow charts allows complex and detailed concepts to be swiftly and effectively reviewed for comprehension and retention. Text within boxes signals the reader to key competencies highlighted by the *Objectives*.

This text is a collaborative project that combines the perspective and insights of students preparing for the examination with the experience of residents and acumen of faculty. The result is a novel and innovative resource to aid in the process of preparing for the MCCQE Part I. As medical school curricula are becoming more tailored to the exam, we believe it will also prove useful in your general studies as well.

We would appreciate your feedback on how to improve this resource and wish you the best success in the MCCQE Part I.

Sheehan H. Chowdhury
Adrian I. Cozma
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NOTE TO READERS

Please read the following carefully:

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CHAPTER

1

Introduction

Sheehan H. Chowdhury • Adrian I. Cozma • Jeeshan H. Chowdhury

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What is the MCCQE Part I?
How to Use This Text?
Clinical Presentation: Objectives Based

WHAT IS THE MCCQE PART I?

The MCC examines medical school graduates and grants licensure to legally practice medicine in Canada. Licensure in Canada is formally obtained through the LMCC, which requires successful completion of the MCCQE Parts I and II. In general, medical students in Canada complete the MCCQE Part I at the end of their undergraduate medical education (just before graduation from medical school) and before beginning their postgraduate medical training (i.e., residency training program).

The MCCQE Part I is a two-part computer-based test. The first section, lasting 3.5 h, consists of 196 MCQs and is completed the morning of the examination day (Table 1.1). The afternoon component consists of the CDM section, a 4 h section of approximately 60 cases, each associated with one to four short-menu or short-written answer-style questions. For both portions of the examination, a table of normal values is provided.

The MCQ section of the examination is divided into 7 subsections (Medicine, Surgery, Pediatrics, Obstetrics & Gynecology, Psychiatry and Population Health, Legal, Ethical and Organizational Aspects of Medicine) of 28 questions each. Each question is in the format of a question stem followed by a list of five answer choices. Only one answer choice is correct for each question. Each question may be accompanied by an image or table.

The CDM section of the examination consists of approximately 80 questions, and focuses on CDM and problem-solving skills. Questions in the realm of differential diagnosis, diagnostic test selection, clinical data collection, and patient management should be expected. In this section, there are short-menu questions, consisting of between 10 and 40 option choices; examinees are asked to either select one answer, a certain number of answer options, or as many answer options as are appropriate. Within the CDM section, short-written response ("write-in") questions should be expected. Responses should be specific, use generic drug names, and worded carefully as directed by the question.

Both sections of the MCCQE Part I are based on the *Objectives for the Qualifying Examination*. The latest version of the *Objectives* was established in 2009 by

TABLE 1.1 • Summary of MCCQE sections

	MCQ	CDM
When	Morning	Afternoon
Time allotted	3.5 h	4 h
Style	Multiple choice	Cases with short menu or written response
Questions	196	~60 cases, 1–4 questions each
Weight	75%	25%
Computer adaptive	Yes	Yes

the MCC, and outlines the expectation of competent physicians, organized around CanMEDS roles.

The CanMEDS framework was created by the Royal College of Physicians and Surgeons of Canada and describes attributes and skills of a competent physician. The framework outlines seven roles: communicator, professional, scholar, health advocate, leader (formerly manager), collaborator, and medical expert. The *Objectives* outline these seven roles, and specifically expand on the medical expert role; they do so by including clinical presentations to highlight the bulk of clinical knowledge expected of graduates.

The **Clinical Presentations** of the MCCQE medical expert objective define the clinical competencies of the medical graduate specific to select common presentations. Within each clinical presentation, the MCC defines the pertinent data collection, diagnostics, clinical problem solving, and management strategies required of the competent examinee.

HOW TO USE THIS TEXT?

Essentials for the Canadian Medical Licensing Exam: Review and Prep for MCCQE Part I is written for medical students and international medical graduates who are preparing to write the MCCQE Part I. As a summative review for the MCCQE Part I *Objectives*, this text will also be of value to medical students through their training both in preclinical and clerkship years, and meet basic needs in postgraduate education.

All the content presented is based on the *Objectives* which "lay[s] out exactly what you have to know for any of the MCC examinations," and which "the MCC test committee use... when they are creating examination questions."

Content is also organized based on the *Objectives*. The text is divided into chapters, which address the main clinical specialties. Topics within each chapter are organized around the **Clinical Presentations**, to expand on the medical expert role of the MCCQE Part I *Objectives*. Many of the clinical presentations have a multispecialty scope, but for ease of reference, we have avoided wherever possible to divide topics into separate chapters.

Chapter 2 is an overview of all the CanMEDS roles. Although distinct from the format of the clinical chapters, this chapter forms a summative review of all the attributes expected of graduates. In the past, the MCC outlined specific objectives for the "cultural-communication, legal, ethical, and organizational aspects for the practice of medicine—C_2LEO." These objectives have been incorporated into the existing objectives and clinical presentations. However, throughout the text of this textbook, you will still see "C_2LEO" boxes that highlight C_2LEO concepts, which are important to know. You will also come across Applied Scientific Concept "ASC" Boxes that emphasize basic scientific concepts of clinical importance.

It is expected that students reading this text will already have a basic conceptual understanding of the material. With this in mind, abbreviations have been used in the text without introducing expansions at first occurrence. A complete list of abbreviations is provided separately in Appendix C. This text organizes and presents material in a highly effective format to allow for a reliable study plan, rapid comprehension, and durable recall that is useful both for examination and during clinical practice.

CLINICAL PRESENTATION: OBJECTIVES BASED

Each clinical chapter contains distinct topics based on the **Clinical Presentations**, of which a list can be found in the Index. Taken directly from the list of MCCQE Clinical Presentations, these topics form the framework of this text. Each topic is further divided into the following subtopics:

DEFINITION/RATIONALE

Outlines the fundamental definitions, scope, and epidemiologic facts of the clinical presentation.

CAUSAL CONDITIONS

Present a systems-based approach for differential diagnosis.

APPROACH/MANAGEMENT

Provides an overview of physical exam, investigations, diagnosis, and management of the clinical presentation.

APPLIED SCIENTIFIC CONCEPT

Reviews basic scientific concepts pertinent to the clinical management of the clinical presentation.

EFFECTIVE VISUAL LEARNING TOOLS

In addition to the clinical presentation and objective-based design of the topics, a number of highly effective visual learning tools are used. These tools succinctly display complex and detailed concepts for swift and highly effective review.

CLINICAL DECISION-MAKING ALGORITHMS

More complex clinical presentations will have diagrammatic CDM trees that focus student attention on clinical approach.

TABLES AND CHARTS

Details and lists are presented in system-based tables that organize information for improved retention and recall.

CLINICAL BOXES

Highlight elements ranging from key concepts, high-yield points, mnemonics, and clinical pearls.

C_2LEO BOXES

Specific applications of C_2LEO aspects of medicine are identified.

ASC BOXES

Emphasize fundamental basic scientific concepts of clinical importance.

RED FLAGS

Underscore emergent matters or potential clues to serious medical conditions.

CanMED BOXES

Highlight opportunities in clinical practice to further develop the attributes expected of competent physicians.

CHAPTER

2

CanMEDS

Gurdeep Parhar • David Leung • Bez Toosi

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Health Advocate
Collaborator
Communicator
Leader (formerly Manager)
Professional
Scholar
Legal, Ethical and Organizational Aspects of Medicine
CanMEDS Summary

HEALTH ADVOCATE

MCC OBJECTIVE

Based on the Health Advocate role of *Objectives for the Qualifying Examination*, 3rd edition.

DETERMINANTS OF HEALTH

- Refer to Chapter 20: Public Health

ACCESS TO HEALTH CARE

Individuals are morally equal and equally worthy of respect. This is not to say that equality of outcomes must follow: not all individuals who show up in hospital should receive equal quantities of morphine, for example. In medical decision making, the fundamental equality of individuals is observed when cases that are similar in morally relevant ways are treated similarly and dissimilar cases dissimilarly.

The "morally relevant ways" usually boil down to need and potential benefit. Differential treatment on the basis of such properties as age, sex, and religion is tolerated **only insofar as** these properties can be demonstrably linked to need and potential benefit. Otherwise, these properties are irrelevant. All other things being equal, granting a white female differential access to reproductive health over a female of aboriginal descent—perhaps by providing better counseling or by providing access to services such as abortion more readily—represents a devaluation of the aboriginal female's interests on the grounds of race. This sort of discrimination fails to recognize the patient as a morally significant being worthy of equal respect.

Legally, equality rights are recognized in Section 15 of the Canadian *Charter of Rights and Freedoms*. Constitutional case law has conceptualized equality obligations into two sorts: Nondiscrimination requires that individuals be treated alike; substantive equality requires that positive measures be undertaken to provide equal access for those whose special characteristics disadvantage them on the basis of race, religion, sex, disability, and so on.

The *Charter of Rights and Freedoms* may apply to hospitals operating under a public mandate, or with public funds. Physicians may also be bound by professional codes of ethics and by provincial human rights statutes that impose similar duties.

In clinical care, this means that discrimination is unacceptable. Resources should be allocated on the basis of morally relevant criteria, using fair and publicly defensible procedures. Positive measures (e.g., sign language or TTD services for the deaf, access to female physicians for female patients whose cultural beliefs prohibit care from a male physician, etc.) should be taken to ensure that the interests of all patients are equally served.

THE CANADIAN HEALTH SYSTEM

In the Canadian constitutional framework (1867), the provinces have primary responsibilities for health care, executed through a range of statutes that vary from province to province. The federal government nevertheless performs an important and varied role in health care that goes beyond merely funding provincial efforts. Particularly important is the federal spending power. The national Canada Health Act framework leverages the use of conditional federal-provincial transfer payments to achieve specific aims among and within the provinces.

THE CANADA HEALTH ACT

The CHA was passed in 1984. The CHA establishes criteria and conditions that must be met before provinces qualify for a full federal cash contribution for health care. Provinces must establish a publicly administered health care insurance program that provides universal, comprehensive, portable, and accessible coverage.

Despite the lack of federal jurisdiction in health care, the CHA framework has fostered the establishment of provincial health care plans along national principles. The public health care system established by the CHA has been characterized as "narrow, but deep": Within the narrow range of services that fall under the notion of "comprehensiveness" (i.e., medically necessary physician, hospital, and surgical-dental services), Canadians are very well provided for. The CHA framework represents an understanding that health care is a social good best provided for through public support and that all citizens deserve adequate care regardless of their circumstances (Table 2.1).

TABLE 2.1 • Conditions of the CHA

Condition	Each Provincial Health Care Insurance Plan Must
Accessibility	Not impede or preclude reasonable access to insured health services[a]
Comprehensiveness	Cover all medically necessary hospital, physician, and surgical-dental (i.e., those that require a hospital setting) services
Portability	Cover new residents to the province within a waiting period of not more than 3 mo; cover residents leaving the province during a waiting period for new coverage; pay for insured services for residents temporarily out of province or out of country[b]
Public administration	Be operated on a nonprofit basis by a public authority designated by the province
Universality	Insure all insurees at uniform terms and conditions

Quebec's health insurance plan does not meet portability requirements. The federal government has not pursued this breech.

[a] This condition is an addition to principles outlined in previous health care legislation. It targets such practices as user charges, which impede access for those with lower incomes.

[b] The rates of pay for out-of-province services are defined according to rates for similar services in the province of delivery. Those for out-of-country services are defined according to rates in the home province.

The CHA has been criticized for defining services that fall under its scope by provider and setting (i.e., physician and hospital services). Health care has changed much since the 1990s. Take-home drugs, home care, long-term care, and the services of allied health professionals have become common and increasingly important to patient-centeredness. For example, home care not only reduces the cost of unnecessary hospitalization but also maintains patient autonomy by allowing the patient to remain independent in the setting of his or her choice for as long as possible. And take-home drugs impose a rapidly escalating cost on patients. Yet, the CHA confers no obligation that provincial insurance plans should provide for these services. For the most part, provinces have voluntarily taken it upon themselves to establish public financing for prescription drugs, long-term care, home care, and certain other services.

PRIVATE HEALTH CARE

The CHA does not outlaw private funding for health care. However, six provinces have statutes that outlaw private health insurance for medically necessary services covered by the public insurance scheme. The other provinces discourage private health care insurance by preventing clinicians from operating in both private and public sectors.

Private sources of funding coexist with public funding for home care, long-term care, and prescription drugs. Additionally, private sources provide most coverage for dental services, vision care, and complementary and alternative medicines. Public insurance funding for these services is minor.

COLLABORATOR

MCC OBJECTIVE

Based on the Collaborator role of *Objectives for the Qualifying Examination*, 3rd edition.

COLLABORATION WITHIN THE HEALTH SYSTEM

The provinces and territories regulate health professionals, hospitals, and other aspects of health care provision. Provinces and territories administer hospital and medical services through a universal single-payer system, remunerate physicians through billing schedules negotiated with the provincial medical association, and run specialized public health services. Provinces, to varying degrees, also provide or fund a variety of home care and long-term care services. All provinces also administer provincial drug plans.

In the last two decades, health care reform efforts have led provinces to adopt geographic health regions that bear responsibility for hospitals, long-term care, home care, and public health. These regions receive global budgets and distribute health resources in light of local circumstances.

- The federal department of health, Health Canada, is responsible for administering the CHA and for regulating drugs, medical devices, natural health products, and biologics.
- The FNIHB of Health Canada is responsible for the health needs of Canada's aboriginal peoples.
- The PMPRB is a quasi-judicial watchdog that reviews and regulates wholesale drug prices for patented drugs.
- The PHAC is a federal agency that performs a wide range of public health functions, and has responsibility for national disease centers and laboratories.
- Statistics Canada helps meet Canada's health information needs.
- The CIHR is Canada's national health research funding agency.
- At the intergovernmental level, the Conference of Federal/Provincial/Territorial Ministers of Health is the premier policy-making instrument. A range of organizations can be considered intergovernmental with various arrangements for funding and governance. Examples include the Canadian Institute for Health Information, Canadian Blood Services, and the Health Council of Canada.

CONSULTATIONS

This can be made into a diagram that outlines the process of the consultation and the important steps:

- Recognize needed expertise and triage based on urgency
- Identify correct consultant/service
- Communicate (verbal/written)
- Ensure appointment made
- Receive verbal/written report
- Carry out recommendations

Professional communication between physicians should:

1. Serve the best interests of the patients
2. Be respectful, collegial, collaborative, and courteous

Responsibilities of the Referring Physician and the Consultant (Table 2.2)

TABLE 2.2 • Responsibilities of the referring physician and the consultant

Referring Physician	The Consultant
• Provide a reason for consultation • Provide contact/demographic information (patient and referring physician) • When possible, state the expectation of the consult • Provide a summary of history, physical findings, medications, allergies, and other physicians involved in care • Provide copies/summaries of relevant investigations, imaging, other consultant reports, and pending tests • Communicate whether other physicians have been consulted for the same problem	To avoid delays • Provide response acknowledging referral and anticipated wait time • Schedule the appointment directly with patient • Advise patient of requirements prior to appointment • Advise patient to contact the consultant or referring physician if there is any change in his or her condition After seeing the patient, the consultant should provide a timely written report including: • Relevant history and findings • Diagnosis/conclusions • Diagnostic and therapeutic interventions implemented and/or recommended • Intended review or follow-up by the consultant

Important tips to keep in mind:

-
- The referring physician should inform the consultant if the estimated wait time is inappropriately long for the patient's condition, or if the patient's condition has changed during the wait period. Consideration should be given for referral to another consultant if the original referred to consultant cannot accommodate.
- Duty of care arises whenever a physician agrees to treat a patient. It is possible that in courts, an interpretation may be made where this responsibility begins when the consultant accepts a referral. Consultants will want to have a system in place to triage consultations based on urgency.
- Post consultation responsibilities should be agreed upon by the consultant and referring physician and communicated to the patient within reason.
- All physicians have an obligation to be accessible (personally or through a delegate). They should provide contact information for themselves or delegates.
- Medical office staff members are an extension of the medical practice of physicians, and the physicians are ultimately responsible for patient care.

HEALTH CARE TEAMS (Table 2.3)

TABLE 2.3 • Health care teams

Role	Scope of Practice
Physician	• The practice of medicine is the assessment of the physical or mental condition of an individual and the diagnosis, treatment, and prevention of any disease, disorder, or dysfunction (Medicine Act, 1991)
Nurse	• The practice of nursing is the promotion of health and the assessment of, the provision of care for, and the treatment of health conditions by supportive, preventive, therapeutic, palliative, and rehabilitative means in order to attain or maintain optimal function (Nursing Act, 1991)

(Continued)

TABLE 2.3 • Continued

Role	Scope of Practice
	• There are different scopes of practice for nurse practitioners, RN, registered practical nurses, etc. For example: ◦ Nurse practitioners—a RN with additional education to prepare for advanced nursing practice in a specific area ◦ Registered nurses—able to autonomously meet the nursing care needs of patients whose needs are not well defined/established ◦ Registered practical nurses—can independently care for patients whose care needs are well defined and the health condition is well controlled
Pharmacist	• The practice of pharmacy is the custody, compounding and dispensing of drugs, the provision of nonprescription drugs, health care aids and devices, and the provision of information related to drug use (Pharmacy Act, 1991) • Pharmacists are medication experts
Dietitian	• The practice of dietetics is the assessment of nutrition and nutritional conditions and the treatment and prevention of nutrition-related disorders by nutritional means (Dietetics Act, 1991) • Dietitians can contribute to health promotion and illness prevention strategies, and develop specialized nutrition therapy and rehabilitation/support strategies to address specific nutrition-related illnesses (Dietitians of Canada, 2001)
Midwife	• Provide primary care to women with low-risk pregnancies—from the time of conception until 6 wk postpartum • Midwives are responsible for supervising the birth process both in home and hospital settings and provide ongoing clinical care for women throughout pregnancy
Chiropodist/ podiatrist	• Provides care through the assessment of the foot and the treatment and prevention of diseases, disorders, or dysfunctions of the foot by therapeutic, orthotic, or palliative means (Chiropody Act, 1991) • They are foot experts and treat patients in numerous ways, including through the use of braces, casts, orthotic devices, physical therapy, or surgery
Social work	• The practice of social work is the assessment, diagnosis, treatment, and evaluation of individual, interpersonal, and societal problems through the use of social work knowledge, skills, interventions, and strategies to assist individuals, families, groups, communities, and organizations to achieve optimum psychosocial and social functioning (Ontario College of Social Workers and Social Service Workers, Code of Ethics and Standards of Practice, 2000)

CONFLICT MANAGEMENT

Difficult physician–patient encounters are often due to a combination of physician, patient, and situational factors.

These encounters can be improved by the following strategies:

- Set prenegotiated time limits to meetings
- Examine your own frame of reference
- Use empathetic listening skills
- Have a nonjudgmental, caring attitude
- Evaluate the patient for medical and mental disorders
- Identify previous abuse
- Set boundaries
- Use patient-centered communication

Physician factors—whenever there is uncertainty surrounding the ability to improve a patient's condition, the physician's self-image as a competent health care professional may be undermined and he or she may act defensively

- Attitudes—insecurity, burnout, time pressures, uncertainty
- Conditions—contextual stressors, health issues, lack of sleep, exhaustion, mental health concerns
- Knowledge—lack of medical knowledge, limited knowledge of patient's medical condition

Skills—lack of communication skills, easily frustrated

Patient factors—the common characteristic trait in challenging patients is the ability to elicit a negative emotional response from the physician (e.g., frustration, anger)

- Behavioral issues
- Conditions—substance abuse, chronic pain syndromes, low literacy, multiple (more than four) medical issues per visit, functional somatic disorders, previous abuse
- Psychiatric diagnosis—personality disorders, anxiety disorders, mood disorders

The CalMER approach

- Catalyst for change
    - Evaluate stage of change
    - Physicians should remind self of what they can and cannot control about the situation
    - Physicians cannot control the patient's behavior, but they can control their own responses
- Alter thoughts to change feelings
    - Physicians should identify which feelings they are experiencing in response to patients and then evaluate how those feelings are affecting the therapeutic physician–patient relationship
    - Ask yourself—"what can I tell myself about this situation that will make me feel less upset?"
- Listen and then make a diagnosis
    - Try to truly listen/see what the patient is trying to communicate through verbal and nonverbal cues
- Make an agreement
    - Focus on making an agreement to continue the physician–patient relationship
    - Confirm explicitly that the patient understands and agrees upon the proposal
- Education and follow-up
    - Physicians should let go of their own agenda (even if they feel that it is more appropriate) and give a "doable" recommendation tailored to the "Stages of Change" model
- Reach out and discuss feelings
    - Reflect upon the experience
    - Identify ways of self-care to deal with next difficult encounter
    - Discuss feelings and experiences with friends and colleagues

COMMUNICATOR

MCC OBJECTIVE

Based on the Communicator role of *Objectives for the Qualifying Examination*, 3rd edition.

COMMUNICATING WITH PATIENTS AND FAMILY

A Patient-Centered Protocol for Breaking Bad News

Patients should be provided with opportunities to know their health information. Admittedly, health information may be difficult to handle, and should be disclosed sensitively. Permission to disclose information should be sought first. The SPIKES protocol published by Baile et al. is useful.

CLINICAL box

SPIKES Protocol for Breaking Bad News

S—Setting up the interview
P—Assessing patient's Perceptions
I—Obtaining the patient's Invitation (i.e., to disclose information)
K—Giving Knowledge and information to the patient
E—Addressing the patient's Emotions
S—Strategy and Summary

ELICITING INFORMATION

One approach to questioning is to advance from open-ended to direct questions. Open-ended questioning is patient centered and allows patients to address their own concerns rather than follow the physician's agenda. However, usually some degree of focusing is necessary on the part of the physician as patients may provide only partial information. By advancing questioning, physicians are able to obtain accurate, detailed information that inform diagnosis.

Questioning Techniques

- Open-ended (essay): "What problems bring you in today?"
- Open-ended (restating): Tell me what your headache felt like
- More directed (short answer): Are you having any other neurologic problems?
- More directed (short answer "Wh" questions): Where is it? When does it happen? What does it feel like?
- Even more directed (multiple choice):
- Extremely directed (Yes/No): Does your chest pain radiate to your neck?

Types of Questions to Avoid

- Leading questions—questions that implicitly suggest an answer—"you haven't had a fever, have you?"
- Multiple/rapid fire questions—questions that force patients to prioritize an answer when in fact they may be experiencing both/all the options presented—"have you had a fever or night sweats?"
- Jargon questions—questions that utilize medical language that the patients might not necessarily understand—"have you ever had a myocardial infarction?"

Facilitating Responses

- Encouragement—minimal comments that allow the patient to continue talking while acknowledging that the physician is paying attention (*Yes? Go on? I see*).
- Silence—strategic pauses can allow patients recollect their thoughts and encourage them to continue speaking.
- Repetition—repetition of the end of sentence (last few words) can encourage the patient to keep talking.
- Paraphrasing—restating your understanding of the problem, situation, etc. allows you an opportunity to consolidate the information you have obtained and verify your understanding with the patient. This also gives them the opportunity to correct/clarify your interpretation.

SHARED PLAN OF CARE

Over the past few decades, the physician–patient relationship has increasingly become viewed as a partnership with the interest of the patient being the focus. SDM is the process of the physician and patient engaging together to develop a plan for patient care.

Key characteristics of SDM (as defined by Charles et al.)

1. At least two participants—physician and patient.
2. Both parties share information.
3. Both parties take steps to build a consensus about the preferred treatment.
4. An agreement is reached on the treatment to implement.

Positive results to be gained from SDM:

- Improved patient satisfaction
- Improved patient adherence
- Decreased depression
- Improved patient well-being

WRITTEN AND ORAL COMMUNICATION

Patient Access to Health Information and the Medical Record

- Physicians have a duty to maintain adequate records for each patient they treat.
- The law specifies minimum time frames for the preservation of medical records (10 yrs in most jurisdictions).
- Patients have a right of access to health information, including the contents of the medical record.

The medical record is subject to physician control and responsibility. Medical staff members have professional duties to document clinical activities, observations, and interactions on a medical record; to maintain the integrity of the record, and keep it up-to-date; to ensure for its secure storage; and to facilitate continuity of care by transmitting copies of the record as appropriate. The physician-clinic maintains ownership over, control of, and responsibility for the medical record.

Patients should be allowed access and control over their health information. For example, a patient's request that a copy of his or her medical record be transferred to a new clinic must be respected. A patient should also be able to review his or her medical record on request. It is reasonable to recover costs incurred by providing access to the medical record, perhaps with a small access fee.

COMMUNICATION WITH THIRD PARTIES

Notifiable infectious Diseases

Infectious disease reporting to public health officials often constitutes mandatory disclosures of health information. Practitioners should be familiar with local regulations. Additionally, it is usually desirable to notify the patient about the required disclosure. This practice may gain the support of the patient. At the least, it helps maintain the bond of trust and transparency underlying the patient–physician relationship.

In the absence of legislation requiring otherwise, medical staff members need not report gunshot wounds, stabbings, admitted use of illegal drugs, or injuries suffered during the commission of a crime. Such information may be obtained by a police officer with a valid court order.

Notifiable diseases often include the following:

- Sexually transmitted infections such as HIV/AIDS, gonococcal infections, *C. trachomatis* infections, mucopurulent cervicitis, LGV, syphilis, and chancroid
- Hepatitis
- Tuberculosis
- Enteric pathogens
- Foodborne illnesses
- Smallpox
- Anthrax
- Viral hemorrhagic fevers, etc.

LEADER (FORMERLY MANAGER)

MCC OBJECTIVE

Based on the Leader (formerly Manager) role of *Objectives for the Qualifying Examination*, 3^{rd} edition.

In 2015, it has been proposed to change the role of "Manager" to "Leader." This change was proposed to better reflect physician's scope of practice in this domain. Going forward, the key competencies reflect renewed emphasis on patient safety and quality-improvement processes; broader inclusion of health informatics; and a greater emphasis on the development of skills to achieve a balance between practice and personal life.

Key Competencies 2015

Physicians are able to:

1. Contribute to the improvement of health care delivery in health care teams, organizations, and systems.
2. Engage in the stewardship of health care resources.
3. Demonstrate leadership in professional practice.
4. Manage their practice and career.

ENGAGE IN THE STEWARDSHIP OF HEALTH CARE RESOURCES

Resource Allocation and Clinical Decision Making

- The physician owes a primary duty to the patient.
- Clinical care (i.e., **micro**level decision making) must not be compromised by cost constraints.

- Resources should be allocated fairly on the basis of morally relevant criteria, that is, need and potential benefit, using fair and publicly defensible procedures.
- The impact of **meso**level and **macro**level rationing decisions should be discussed with the patient in a supportive way.
- Resources should be deployed prudently.

Resource allocation decisions concern questions of justice: How are resources fairly distributed among health needs? On what basis is it acceptable to make these decisions? The basis, whether intentional or unintentional, for differential access to health care goods and services among patients should meet ethical and legal standards for fairness (Table 2.4).

TAbLE 2.4 • Levels of health care resource allocation

	Macrolevel	Mesolevel	Microlevel
Body	Federal and provincial	Health region/ institution	Physician
Types of decisions made	Global budget	Services and access conditions	Clinical decision making
Considerations	Makes decisions incorporating considerations of costs and competing interests	Makes decisions incorporating considerations of costs and competing interests	Advocates for the patient—clinical decisions should be driven entirely by patient need and potential benefit
Resources	Determines resource frameworks and constraints	Determines resource frameworks and constraints	Works within resource frameworks and constraints
Examples	Health insurance policy, federal transfer payments	Decision to add ICU beds, ICU admissions policy	Prescription decisions, aggressive vs. conservative approaches

Prudent Use of Clinical Resources and the Obligation to Seek the Patient's Best Interests

In the late 1980s and 1990s, governments, perceiving budget deficits and rising health care costs, embarked on a series of health care reform initiatives. As a side effect, physicians have felt pressure to contain costs, for example, by minimizing the use of expensive modalities. In the negligence case, *Law Estate v. Simice et al.*, physicians accused of negligence in failing to provide a patient with a medically necessary CT scan mentioned cost constraints. In response, British Columbia Supreme Court Justice Spencer writes:

> If it comes to a choice between a physician's responsibility to his or her individual patient and his or her responsibility to the Medicare system overall, the former must take precedence in a case such as this. The severity of the harm that may occur to the patient who is permitted to go undiagnosed is far greater than the financial harm that will occur to the Medicare system if one more CT scan procedure only shows the patient is not suffering from a serious medical condition. (*Law Estate v. Simice*)

Cost constraints should not interfere with clinical care. First, physicians, owing a duty of care to their patients, must meet the standard of care that can be expected from a reasonable practitioner of similar training and experience. Cost constraints are no defense against negligence. Second, physicians are fiduciaries in a trust relationship with their relatively vulnerable patients. They are duty-bound to look after the interests of their patients with the utmost loyalty. Because the cost of physicians' services in Canada is borne by the Medicare system, allowing cost considerations into clinical reasoning amounts to the entry of a third-party interest. Physicians are duty-bound to resist this intrusion and to maintain the independence of their clinical judgment. Where cost constraints do affect clinical decisions, perhaps because of limitations imposed at the mesolevel and macrolevel, physicians need to discuss, in a sensitive manner that avoids laying blame, the effects of cost constraints, available treatment alternatives, and the means of accessing them.

This does not mean, of course, that physicians should not use resources prudently. Physicians may need to mediate a common understanding of fair and prudent care with patients. Excessive treatment, or treatments of marginal benefit, may subject patients to more harm than good. Physicians, having many patients, are also fiduciaries to many beneficiaries. Moe Litman suggests that physicians might apply the legal concept of "keeping an even hand among beneficiaries" as a lens. Not to be applied literally, this principle is satisfied if "allocation decisions are made on a non-personalized, relatively objective basis, in accordance with appropriate principles intended to maximize the health care of patients." In the clinic, this means:

- Choosing interventions known to be beneficial on the basis of evidence
- Minimizing the use of marginally beneficial tests or interventions
- Seeking the tests or treatments that will accomplish the diagnostic or therapeutic goal for the least cost
- Advocating for one's own patients, but not manipulating the system to gain unfair advantage to them

Physicians are not obliged to provide interventions that are harmful or futile, though the notion of futility needs to be approached with respect for alternative conceptions of "meaningfulness" in health care. The duty to seek consent, that is, a duty not to treat patients against their will, does not imply a positive duty to treat. Physicians **are** bound by professional ethics and by the law of negligence to provide a professional level of care, but not to satisfy every desire.

PROFESSIONAL

MCC OBJECTIVE

Based on the Professional role of *Objectives for the Qualifying Examination*, 3rd edition.

ACCOUNTABILITY TO SELF

Challenges to professionalism interfere with the ethical and clinically independent practice of medicine according to commonly accepted norms and standards. Personal factors, such as alcoholism, overwork, marital strife, loneliness, and financial distress, may affect an individual's ability to practice medicine. The line between the professional and the personal can be indistinct. Personal problems may affect patient care. Equally, professional responsibilities may weigh down personal life. Professionalism therefore requires achieving balance and equanimity in both clinical **and** personal matters.

Impairment occurs when personal factors interfere with the professional practice of medicine. Physicians have a duty to prevent practice under the influence.

ACCOUNTABILITY TO PATIENTS AND THEIR FAMILIES

The Nature of the Patient–Physician Relationship

The patient–physician relationship is a fiduciary relationship. The physician is bound to:

- Serve the patient's interests with due care and diligence
- Refrain from conflicts of interest
- Resolve all conflicts of interest in the patient's favor

Moreover,

- The fiduciary relationship confers a legal duty of the utmost loyalty
- Trust is essential to the patient–physician relationship. The patient is entitled to have faith in the relationship's integrity
- The patient–physician relationship is patient centered
- Physicians must provide continuous and accessible care, and never abandon their patient. The relationship is terminated when:
    - Care has been transferred
    - Adequate notice has been given for the patient to make alternative arrangements

ACCOUNTABILITY TO SOCIETY

The law recognizes the patient as a person with human and other legal rights, including the right to security of person and inviolability, and the right to freedom from discrimination. These rights are formulated at a constitutional level, in the Canada **Charter of Rights and Freedoms**. In addition, both common and civil law recognize a fundamental right to self-determination. Rights are trumps that can normally be expected to take precedence over other considerations. However, rights may be legitimately limited for certain social interests. Specific instances under which individual rights must give way are recognized in various statutory and nonstatutory laws.

The law also recognizes the physician as a person to whom duties apply. Indeed, the patient–physician relationship has been described as a fiduciary relationship, imposing on physicians one of the highest standards of conduct recognized at law. In a fiduciary relationship, the physician is an agent acting on behalf of a vulnerable party, and is obliged to act solely in that party's interests at all times. Current physicians, as the stewards of trust inspired by generations of previous professionals, are obliged to honor and nurture this relationship for future generations of physicians.

Physicians must follow through on undertakings made to patients, must not exploit the relationship for personal advantage, and must maintain and respect professional boundaries at all times. Physicians are obliged to provide for continuous and accessible care, and never to abandon their patients. These basic duties arise from ethical and legal understandings of the patient–physician relationship, and are terminated only when care has been transferred, or after adequate notice has been given to allow the patient to make alternative arrangements. The patient–physician relationship, as the central fixture of medical practice, permeates medicine's legal, ethical, and organizational aspects.

Duty to Warn

There are occasions when a physician's duty to society may outweigh the obligation of physician–patient confidentiality, thereby justifying the voluntary disclosure of information about a patient to the appropriate authority. The Supreme Court of Canada has acknowledged a public safety exception to physician–patient confidentiality.

The following three factors should be considered (the importance of each will vary depending on the specifics of each individual case):

- There is a clear risk to an identifiable person or group of persons
- The risk is one of serious bodily harm or death
- The danger is imminent

Key issues to keep in mind:

- Would a reasonable person consider the potential danger to be clear, serious, and imminent?
- The information disclosed should be limited to only what is necessary
- Ask for advice and counsel

ACCOUNTABILITY TO THE PROFESSION

Professionalism refers to the practice of medicine according to a common set of norms and standards, characterized by ethical conduct, clinical independence, and self-regulation. Physicians are charged by statute, and obliged by social contract, to set and uphold these common standards of conduct. Additionally, standards of professional conduct translate principles of patient autonomy, beneficence, nonmaleficence, justice, and patient-centered care into clinical practice. Adhering to professional norms ensures sound care, helps guarantee fidelity to the core principles of medicine, and maintains the public's trust in the profession (Figure 2.1).

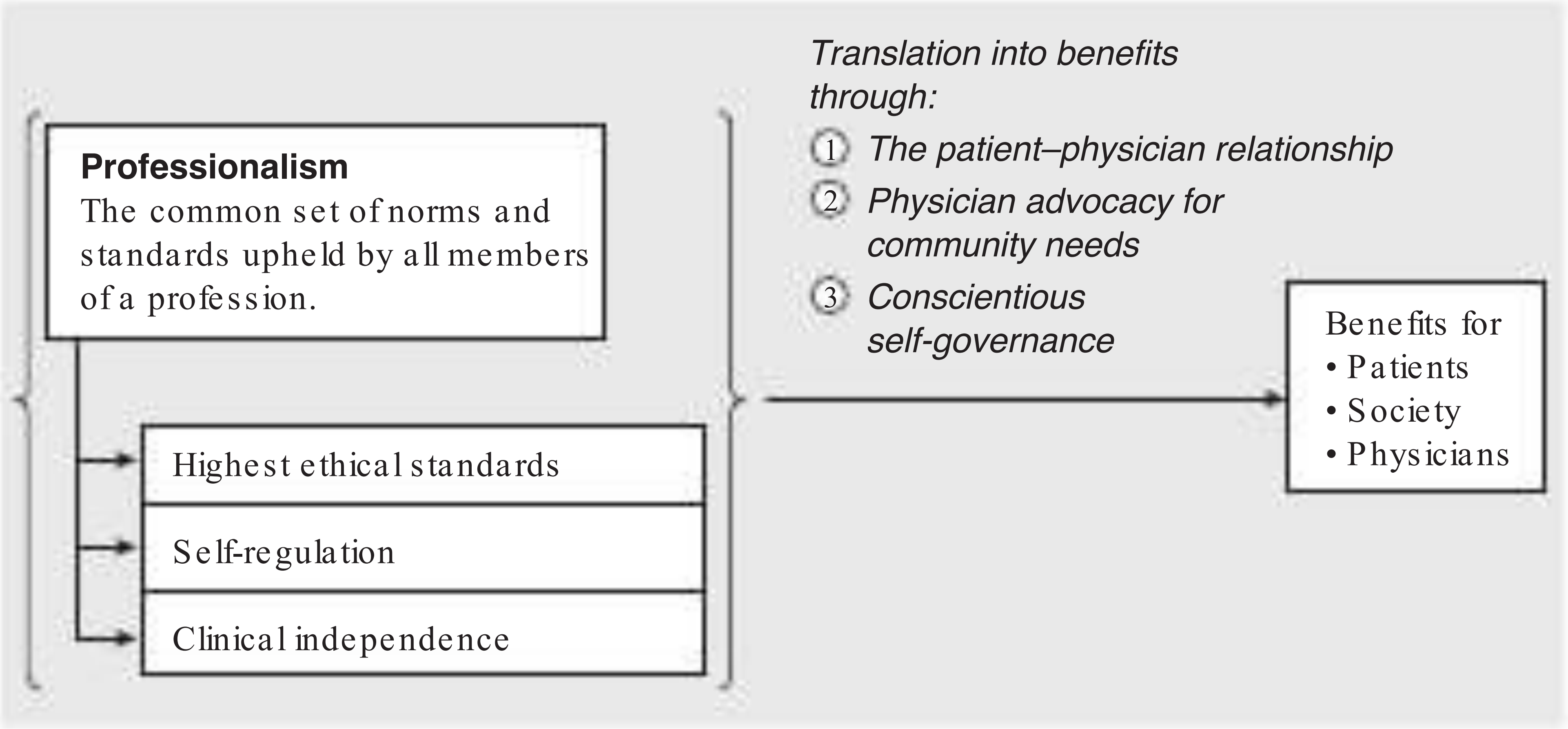
Professionalism
The common set of norms and standards upheld by all members of a profession.
Highest ethical standards
Self-regulation
Clinical independence
Translation into benefits through:
① The patient–physician relationship
② Physician advocacy for community needs
③ Conscientious self-governance
Benefits for
• Patients
• Society
• Physicians

Figure 2.1. Professionalism. With abstractions from the CMA policy, Medical Professionalism.

Certification and Licensing

The two barriers to entry into the health care market are certification and licensure.

In a certification regime, certain agencies are granted exclusive powers to certify individuals as having met particular performance or educational standards. The national character of these organizations means that the medical degree and certification are portable from province to province.

Canada's physician certification bodies include the following:

- CFPC—Family Practice
- RCPSC—Specialty Practice
- MCC—Independent Medical Practice

Under a licensing regime, unlicensed individuals are legally prohibited from providing certain services. Provincial physician-run colleges or boards govern licensing. Licensure is nontransferable from province to province, and must be sought and awarded by the college or board responsible for medical licensing in each province of practice. Additionally, provincial colleges typically require certification from the MCC, as well as certification from one of the CFPC or RCPSC. In practice, then, uncertified physicians are excluded from medical practice, although certifying bodies bear no responsibility for licensing.

Self-regulation

Physician certification and licensing bodies are self-regulating. However, the interests of the profession may occasionally clash with the interests of the public. To prevent conflicts of interest, distinct medical associations—the CMA and its provincial chapters—carry out professional advocacy separately. Medical associations neither certify nor license, and membership is voluntary. Medical student and resident associations perform analogous functions for medical students and residents, respectively.

Finally, the CMPA, a legal defense fund, looks after the legal interests of individual practitioners. In return for annual membership fees, the CMPA provides members with legal representation in the event of a malpractice suit, and foots the bill for settlements or damages awarded to plaintiffs.

Output Regulation

Output regulation concerns physician performance, specifically deficient care or conduct. Penalties assessed against lacking care provide an incentive to maintain professional standards. Disciplinary proceedings, whereby provincial colleges leverage their powers to grant, revoke, or suspend medical licensure to penalize breaches of professional standards, are an important form of output regulation. Legal liability is another form of output regulation.

C_2 1 E O

Summary Box

Regulation of Medical Practice

- Health care is an imperfect market. Unregulated, it would subject consumers to unacceptable risk.
- Physicians' competence and conduct is legally (and ethically) regulated to protect patients and society in general.
- The objectives of regulation are performed by self-regulating physician licensing and certification bodies.
  - Certification indicates that a practitioner has met certain requirements of education, knowledge, and competency. Certification bodies include the MCC, the CFPC, and the RCPSC.
  - Licensure from a provincial board or college is a legal requirement for medical practice.
  - Licensure is nontransferable between provinces.
  - Physician representation and advocacy are carried out by distinct medical associations (i.e., the CMA and its provincial chapters) separate from the regulatory functions of licensing and certification.
  - The CMPA is a medical defense association.

Integrity

- Understand and act appropriately in complex ethical situations
  - Physician-assisted suicide
  - Maternal–fetal conflict
  - Abortion
  - Advanced reproductive technology
  - Genetic testing and manipulation

Physicians and Industry

Drugs consume more and more health care spending every year—spending that remunerates pharmaceutical companies. Because physicians direct and control consumer access to the prescription drug market, the pharmaceutical industry has a commercial interest in influencing physician-prescribing practices. Commercial interests further the public good when pharmaceuticals encourage the adoption of safer, more effective, or more cost-effective treatments. They set the public back when, for example, expensive drugs with no benefit over cheaper alternatives are aggressively marketed, or when physicians experience pressure to suppress negative clinical outcomes. With respect to drugs, physicians need to assess industry claims independently, on the basis of sound evidence, to maximize the social benefit of the commercial incentive. More generally, physicians should maintain their professional distance and clinical independence (Table 2.5).

C_2 1 E O

Physicians and Industry

Relationships with pharmaceuticals:

- Are regulated by an ethical code
- Must not affect independent clinical judgment
- Must not impinge on duty to one's patients

TABLE 2.5 • Professional expectations of physician–pharmaceutical interactions

Situation	Expectation
Drug samples	Should not result in material gain for the physician or practice
CME	Physician-organizers must control organization, content, and choice of activities Funds from commercial sources should not be directed to individual attendees (e.g., no industry funding of individual travel bursaries) Allocation of promotional displays should not be influenced by sponsorship
Industry-sponsored research	Sponsors should guarantee that results will be made public within a reasonable period Remuneration for enrolling patients is unacceptable, except to recover costs Physicians should disclose relevant relationships with the industry to research subjects and academic journals
Investment in pharmaceuticals	Should be avoided if it might inappropriately affect clinical practice
Personal gifts	Should not be accepted
Teaching aids	Are acceptable only if they do not refer to specific agents, services, or products

Selected and abridged from the CMA Policy, Physicians and the Pharmaceutical Industry.

CONFLICTS OF INTEREST IN RESEARCH

Many entities influence and have a stake in the research enterprise. Of these interests, the commercial link between industry and the research community has attracted much attention. Industry contributes significantly to health research, undoubtedly facilitating research that otherwise would not be possible. Where the scientific and ethical standards of research are upheld, the commercial incentive may be socially beneficial. However, numerous commentators and high-profile cases of commercial conflicts of interest have brought public attention to bear on commercial involvement in research. For example, in 1996, Dr. Nancy Olivieri identified adverse effects of the drug deferiprone during a clinical trial. The pharmaceutical company and research sponsor, Apotex, insisted that she abides by confidentiality clauses attached to her research funding, jeopardizing the safety of her research participants.

The fiduciary responsibility of a physician to his or her patients is a duty of utmost loyalty. It requires that the fiduciary refrains from conflicts of interest and, where this is not possible, that the fiduciary resolves conflicts of interest in the patients' favor. Applied to the research setting, this means that physicians are obliged to disclose conflicts of interest to regulators and to patients when performing disclosure for consent. Physicians should maintain their scientific and clinical independence, and must resolve conflicts of interests in favor of research participant welfare.

ALTRUISM

Altruism can refer to a motivation or behavior that aims to benefit another's well-being. In the context of patient care, altruism can be behaviors that go above and beyond expected duties in patient care. Altruism is balanced with self-care and the maintenance of personal health in providers with the aim of sustaining work–life balance.

Examples of altruism:

- Working beyond contracted hours
- Giving free treatment to poor patients
- Willingness to go the extra mile in advocating for patients
- Making home visits to patients unable to be seen in clinic
- Writing letters to help a patient obtain an otherwise unaffordable medical device

However, if medical trainees and physicians are unable to maintain self-care and either focus too much attention on their patients or themselves, they are predisposed to difficulty in their careers and personal lives. Burnout is a psychological state characterized by emotional exhaustion, depersonalization, and a decrease in personal accomplishment with one's career.

- Factors that predispose to burnout:
  - Long working hours
  - Lack of autonomy
  - Work–life imbalance
  - Lack of social resources
  - Emotional and interpersonal stressors
- Burnout decreases:
  - Quality of patient care
  - Empathy
  - Altruism
  - Career satisfaction
- Burnout increases
  - Patient objectification
  - Patient dissatisfaction
  - Mood disorders in providers
  - Substance use and abuse in providers

SCHOLAR

MCC OBJECTIVE

Based on Scholar role of *Objectives for the Qualifying Examination*, 3rd edition.

CONTINUED EDUCATION

Physicians report spending an average of 50 h/yr on continuing medical education with the aim of improving performance and patient outcomes. The range of activities is hugely variable, along a spectrum of activities from didactic large group lectures to interactive small group problem-based learning. In terms of effectiveness, reviews of the literature have found that didactic lectures are less likely to have a significant impact on improving physician performance or patient outcomes. Rather, interactive sessions (i.e., case discussion, role-play) have shown more of a benefit. Likely it is because these interactive sessions better incorporate principles of adult education.

Examples of continuing medical education activities:

- Rounds, educational meetings, conferences, refresher courses, programs, seminars, lectures, workshops

Characteristics of effective adult education:

- Learner centered
- Active (as opposed to passive)
- Relevant to the learner
- Engaging
- Reinforcing

APPLYING RESEARCH AND INFORMATION MANAGEMENT

Answering Research Questions: The PICO Approach (Table 2.6)

TABLE 2.6 • Answering research questions: the PICO approach

P: Population of interest	Patient or problem to be addressed
I: Intervention	Exposure to be considered—treatment/tests
C: Control	Alternative control or comparison intervention (treatment/placebo/standard of care)
O: Outcome	Outcome of interest

Research Ethics

Ethical research involves a balance between patient welfare interests and the social benefits of research.

- Patient autonomy and the right of self-determination are privileged.
- Fully informed and voluntary consent is the default norm, but consent and disclosure standards vary for different sorts of research and for research with different populations.
- Patients cannot consent to otherwise unethical research.
- Sound and ethical research meets a high standard of scholarly merit and minimizes the risk to which patients are exposed.
- Conflicts of interest must be disclosed.
- Human research should be approved by and accountable to an independent REB.

Canada's Research Regulatory Framework and REBs

Canada lacks comprehensive human research legislation. Instead, there are a number of statutes that relate to various aspects of research, in patchwork fashion. There are quasi-legal guidelines and recommendations, which fall into two categories.

- Ethical codes and conduct guidelines developed by professional organizations form a body of professional norms. These include the following:
  - CMA Code of Ethics
  - World Medical Association's Helsinki Declaration
- Guidelines developed by research funders, the most notable of which is the tri-council (i.e., joint CIHR, NSERC, and SSHRC) policy statement, Ethical Conduct for Research Involving Humans.

Aspects of research proposals—for example, research design and purpose—require scientific expertise to assess. Yet, the researcher cannot be the final arbiter of his or her own proposal. Generally, research must be independently reviewed by an institutional REB. REBs integrate scientific, clinical, ethical, legal, and community representation in light of relevant circumstances to review a research proposal's scholarly and ethical value.

THE LEARNING OF OTHERS

Interprofessional education

Interprofessional education has been defined as the occasion when two or more professions learn from and about each other to improve collaboration and the quality of care. The following strategies may help improve interprofessional education:

- Base teaching methods in educational theory
- Create a nonthreatening learning environment
- Develop reflective practitioners
- Create relevant learning experiences
- Employ a variety of teaching and learning strategies
- Consider structural factors of groups
  - Group balance (an equal number of different types of professionals)
  - Group size
  - Group stability (group members remain consistent with little turnover)

Patient education

The aspects of communication relevant to discussion of the management plan that were found to significantly influence health outcomes can be found in Table 2.7.

TABLE 2.7 • Aspects of patient communication found to significantly influence health outcomes

Patient Factors	Physician Factors
• Patient is encouraged to ask more questions • Patient is successful in obtaining information • Information programs and packages are provided	• Physician provides clear information and emotional support • SDM • Patient–physician agreement about the nature of the problem and the follow-up plan

LEGAL, ETHICAL AND ORGANIZATIONAL ASPECTS OF MEDICINE

MCC OBJECTIVE

Based on Objective #121 (Legal, Ethical, and Organizational Aspects of Medicine) and sub-Objectives #121-1 (Consent), #121-2 (Truth Telling), #121-3 (Negligence), #121-4 (Confidentiality), and #121-5 (Legal System) of *Objectives for the Qualifying Examination*, 3rd edition.

CONFIDENTIALITY

Privacy versus Confidentiality

- Privacy refers to the patient's control over knowledge of his or her personal affairs.
- Confidentiality refers to the physician's duty to safeguard information disclosed by patients. Confidentiality protects patients' privacy.

Ethical and Legal Considerations

- Underpinned ethically by autonomy and beneficence, and legally by fiduciary duty
- Is an essential part of the patient–physician relationship and facilitates trust
- Health information **must** be disclosed to a third party when:
  - The law requires reporting
  - To prevent serious harm from befalling a third party, that is, **duty to warn**
  - To prevent serious harm from befalling the patient
  - Where a valid court order requires disclosure
  - Where the patient requests or authorizes that health information be transferred
- The patient should be notified of a required disclosure
- Common mandatory disclosures with which physicians should be familiar vary from province to province, and may include the following:
  - Communicable diseases
  - Suspected child abuse or abandonment
  - Fitness to operate a motor vehicle

- Decision-capable minors are entitled to confidentiality
- Anonymized or de-identified information is generally not considered private, but should be created or used carefully nonetheless
- Confidentiality rules and exceptions are complicated; guidance should be sought from the professional college

In Practice

Reasonable precautions to maintain confidentiality are:

- Limiting information disclosed over phone
- Avoiding the transmission of health information by fax or e-mail
- Securing charts and maintaining computer network security
- De-identifying patient data for presentations or educational and research purposes

Certain provinces have enacted statutes with the primary aim of regulating the treatment of health information (e.g., Alberta's *Health Information Act*). These statutes outline the responsibilities of health information custodians and patients' rights in respect of their information (Table 2.8).

TAbLE 2.8 • Disclosures of health information

Keywords	Scenario	Mandatory
Nonstatutory		
Court order	Upon request of a court order	X
Executor of estate	To the executor of the estate, for a deceased patient; the executor represents the deceased legally, not the next of kin	X
Patient consents	With patient consent, any use or disclosure is permissible	
Parents, minor patient incapable	Upon request of a patient's parents, but not where the patient is a mature minor	X
Patient directs	Must disclose information to a third party as directed or authorized by the patient	X
Federal Jurisdiction		
Aviation safety[a]	Medical conditions of flight crews, air traffic controllers, and others, where the condition is a threat to aviation safety	X
Mental illness, violent[b]	Patients treated for mental illness associated with violence or threatened violence	X
Railway safety[c]	Medical conditions of railroad workers in safety critical positions, where the condition is a threat to public safety	X
Provincial Jurisdiction		
Animal bites	Animal bites in which rabies is suspected	X
Board, statutory	Upon request of a Board or Tribunal, empowered by statute to issue subpoena (e.g., Attendance Board, School Act)	X
CA	Pathologic reports indicating malignancy	X
Caregiver	To a person responsible for providing continuing care and treatment to the patient	
Child abuse	Suspected child abuse	X
Deaths, suspicious	Deaths under certain conditions (e.g., unexplained deaths, or deaths consequent to negligent care)	X
Discipline, professional	To the College of Physicians and Surgeons of Alberta pursuant to an investigation	X
Diseases, communicable	Certain communicable diseases	X
Diseases, notifiable under OHS	Specific notifiable diseases (e.g., lead poisoning, asbestosis, and noise-induced hearing loss)	X
Family members	To family members or individuals close to the patient, or for purposes of contacting such individuals, if the information is in general terms and not contrary to the patient's express wishes	X
Legal guardian	Upon request of patient's legal guardian, with documentation of appointment	X
Motor vehicles	Persons medically unfit to drive	
Persons in care	Suspected abuse of a "person in care"	X

(Continued)

TABLE 2.8 • Continued

Keywords	Scenario	Mandatory
WCB	Upon the request of the WCB, only information relevant to work-related injuries likely to disable the patient from work for more than 1 d	X
Danger to others[d]	Patients who present a clear and substantial danger to society	?

This table is based on Alberta disclosures as of 2005. Disclosures not marked "mandatory" are meant to be considered "permissible" or "discretionary."
Where the table references a federal statute, the disclosure applies uniformly across Canada. Otherwise, disclosure obligations are developed in provincial statute or case law, and vary from province to province. Practitioners must be familiar with regulations in their own jurisdictions.

[a] Aeronautics Act (Federal Statute).

[b] Firearms Act (Federal Statute).

[c] Railway Safety Act (Federal Statute).

[d] The case-precedent suggesting a duty to disclose in this situation is an American case, Tarasoff v. Regents. This duty has not been tested in Canadian jurisprudence.

(College of Physicians and Surgeons of Alberta. Release of Medical Information: A Guide for Alberta Physicians. Edmonton, AB: College of Physicians and Surgeons of Alberta,; 2005. http://www.cpsa.ca/).

CONSENT

- Is required, ethically, by respect for patient autonomy and, legally, by the patient's common law right to self-determination and by statute, where applicable
- Is required whenever treatment or diagnostic options are recommended
- Refers to specific interventions performed at particular times and places by certain personnel
- The treating physician is ultimately responsible for ensuring consent
- Requires:
  - Disclosure of information
  - Voluntarism
  - Capacity
- The patient has the right to refuse consent, even when this may lead to death. Consent may be withdrawn at any time without prejudice on the level of clinical care provided

Disclosure

Meaningful decision making requires that individuals be apprised of information relevant to their circumstances. Only then can the decision be attributed to their authentic preferences.

In *Reibl v. Hughes*, the court decided that adequate disclosure should include whatever a reasonable person in the patient's circumstances would want to know. This usually includes:

- Nature of the intervention
- Gravity of the patient's situation and of intervention
- Material risks and benefits, including special or unusual risks
- Alternatives and consequences of nonconsent
- Information regarding delegation of care
- Patient questions must be addressed

Information should be presented in broad terms and simple language. Translation services should be sought to address linguistic barriers. Information should account for extra-medical (e.g., social and financial) circumstances. And the treating physician should check for patient understanding.

Voluntarism

Voluntarism refers to freedom from coercion so that a patient's authentic sense of what is best can guide medical decisions. Is the patient free to act "in character," in accordance with those values and interests formed throughout the patient's life?

Voluntarism can be thought of as freedom from external interference. These include pain, a rushed environment, local resource scarcity, physical restraints, and coercive family dynamics. A family conference may be appropriate. Hospital ethicists should be consulted for difficult cases.

Capacity

Capacity refers to the ability to consent or refuse consent to medical treatment. According to the Ontario *HCCA*, the capable patient is "able to understand the information that is relevant to making a decision" and "able to appreciate the reasonably foreseeable consequences of a decision or lack of decision."

There is no one-size-fits-all or easy way of assessing capacity. Capacity does not refer to global cognitive or affective status, as assessed, for example, by the Folstein MMSE, although bad MMSE performance may lead a physician to suspect the patient's capacity.

Capacity is:

- Specific—it refers to a patient's ability to make a particular decision. A patient incapable of making one decision is not necessarily incapable with respect to another.
- Dynamic—it changes with time and circumstance. Capacity should be assessed and reassessed regularly, and for different sorts of decisions.
- Affected by many factors—reversible factors (disease, drug use, depression, etc.) should be addressed, and important decisions delayed until capacity is restored, if possible.

Where the stakes resting on a capacity determination are substantial, a formal assessment by a psychiatrist and/or an ethicist consultation should be sought.

Capacity goes beyond simple understanding: to **appreciate** one's circumstances, the patient must **be able** to recognize that he or she has a condition to which the treatment and its consequences might apply. **Also, nonconsent does not constitute evidence of incapacity,** and medical staff members must be open to idiosyncratic perceptions of health and wellness.

C_2 1 E O

Review Box

Voluntarism and Capacity

Voluntarism

- Minimize coercive influences or influences that interfere with decision making, for example, provide adequate pain control.

Capacity

- A process standard of capacity applies: Is the patient able to understand and appreciate information? The consequences and alternatives to action or nonaction?
- Capacity is specific for each decision.
- Capacity does not equal global cognitive status.
- Capacity may fluctuate.
- The patient should be allowed to direct treatment as much as possible.
- Refusal to consent does not equal incapacity.
- Minors and mentally disabled patients raise special issues for capacity.
- If the patient is not competent, consent may be obtained from a court, parent, or SDM according to provincial law and specific circumstances.
- At least two justifications for proxy or substitute decisions should be recognized: what the patient would have wanted and the best interests standards; the acceptability of the justification will depend on the circumstances.

Exceptions to Consent

Emergency Care Situations

When a patient presents in an urgent care setting, efforts should be undertaken to facilitate consent (e.g., find a translator for a capable non-English speaker, or locate a SDM for an incapable patient). This might not be feasible in emergencies, where delay could lead to significant bodily harm. In such situations, it would be better to err on the side of bodily integrity: Treatment should occur without delay.

However, the emergency exception does not apply where there is reason to believe that the patient would refuse treatment if he or she were capable. In *Malette v. Shulman*, an emergency physician was held liable for initiating a life-saving transfusion on an incapable car accident victim, despite his awareness that a card declaring refusal of blood products for religious reasons had been found in the victim's purse.

Other Situations

Provincial public health statutes require compulsory diagnostic testing or treatment in suspected cases of certain infections. Mental health statutes may also provide for admission to hospital without consent. These vary from province to province. Legislation may also require that an SDM consent to diagnostic or therapeutic interventions, after admission.

The Incapable Patient

A patient may be unable to understand the medical problem, the proposed treatment, alternatives, or consequences of consent/nonconsent. The patient may be unable to appreciate his or her situation, that is, unable to recognize that he or she has a condition to which this information applies. He or she may be unable to make a decision that is not substantially based on delusion or depression. This patient is incapable (Figure 2.2).

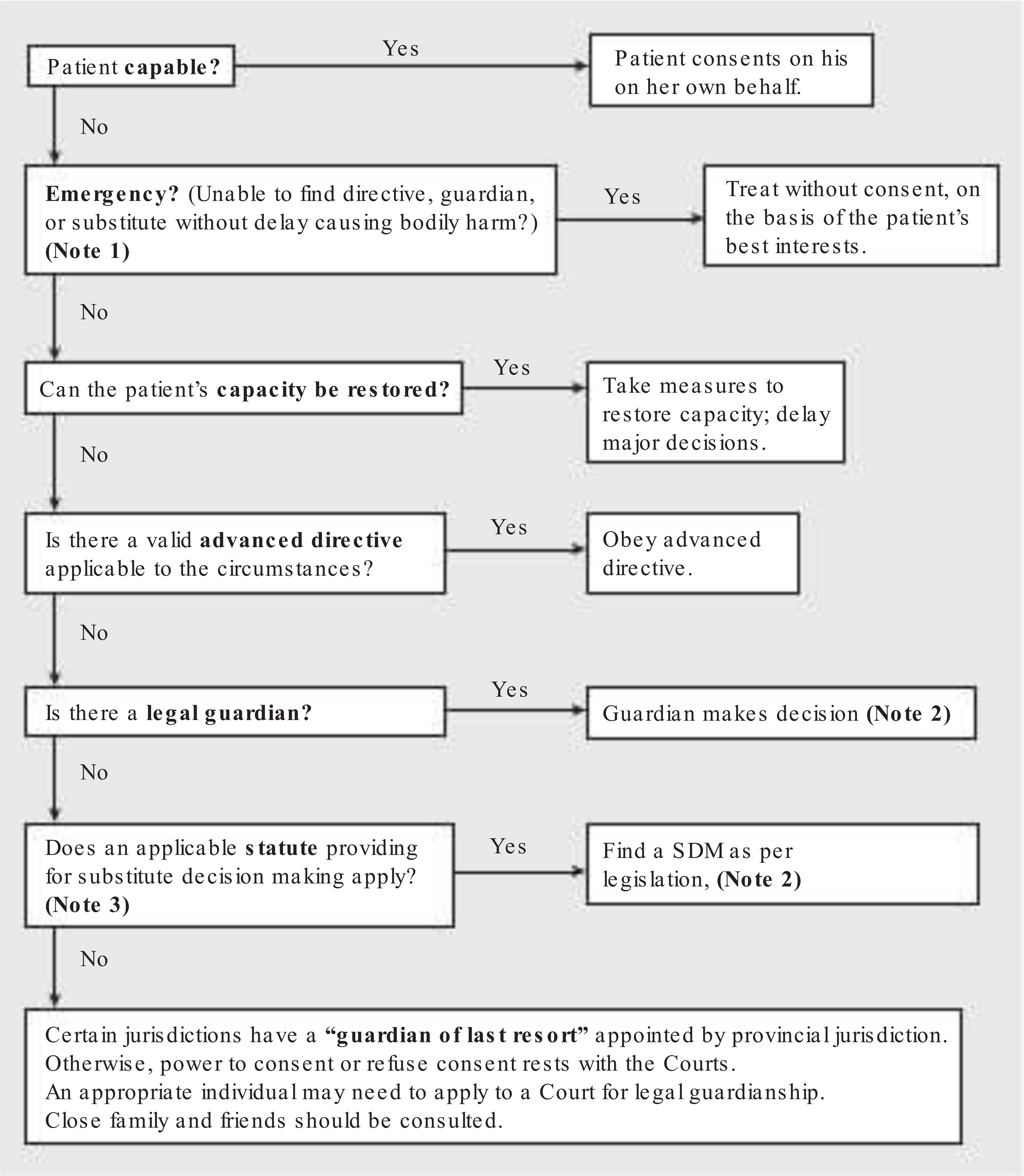
Patient capable?
Yes
Patient consents on his on her own behalf.
No
Emergency? (Unable to find directive, guardian, or substitute without delay causing bodily harm?) (Note 1)
Yes
Treat without consent, on the basis of the patient's best interests.
No
Can the patient's capacity be restored?
Yes
Take measures to restore capacity; delay major decisions.
No
Is there a valid advanced directive applicable to the circumstances?
Yes
Obey advanced directive.
No
Is there a legal guardian?
Yes
Guardian makes decision (Note 2)
No
Does an applicable statute providing for substitute decision making apply? (Note 3)
Yes
Find a SDM as per legislation, (Note 2)
No
Certain jurisdictions have a "guardian of last resort" appointed by provincial jurisdiction.
Otherwise, power to consent or refuse consent rests with the Courts.
An appropriate individual may need to apply to a Court for legal guardianship.
Close family and friends should be consulted.

Figure 2.2. Consent algorithm for incapable patient.

Note 1: Evidence of a patient preference, even in the event of a life-threatening emergency, must nonetheless guide decision making (e.g., *Malette v. Shulman*).

Note 2: SDMs are duty-bound to act on what the patient would have wanted if he or she were capable. If the patient was never previously capable to make health care decisions, is a minor, or if the patient's wishes are unknown, substitutes should apply the best interests standard.

Note 3: Applicable statutes include child welfare statutes (e.g., Alberta's *Child, Youth and Family Protection and Enhancement Act*), mental health statutes, and statutes concerning dependent adults.

Ethical and Legal Considerations

When patients are incapable, their decision making—or lack thereof—may subject them to undue harm. Moreover, decisions made in these states cannot meaningfully be said to be rooted in the values and beliefs that comprise a consistent self-identity. That is to say, decision making is no longer autonomous.

At least two justifications for proxy or substitute decisions should be recognized: What the patient would have wanted and the best interests standards; the acceptability of the justification will depend on the circumstances.

- Personal directives and substitute decision makers are duty-bound to consider what the patient would have wanted if he or she were capable. The right to control one's own body continues, even during a period of incapacity or during a life-threatening emergency.
- For some incapable patients, such as young children or patients who have had lifelong and severe mental handicap, consent should be sought from the patient's guardian or an appropriate SDM, who is obliged to act in the patient's best interests.

Age and Capacity

- Physicians **must** report a parent's failure or refusal to seek necessary medical therapy to child protection authorities.
- Age does not necessarily correlate with capacity.
- Under the common law doctrine of the mature minor, minors are presumed capable, unless a specific assessment reveals incapacity.
- The preferences of a capable minor must be respected.
  - Their decision making will integrate (to varying degrees):
    - Medical opinion
    - Patient preferences
    - Family preferences
- Statutory law may supersede common law.
  - British Columbia's *Child Family and Community Services Act* allows the court to order treatment, where a child or his or her guardians refuse to consent for treatment necessary to "preserve the child's life or to prevent serious or permanent impairment of the child's health" (*B.* [*S.J.*] *v. British Columbia* [*Director of Child, Family and Community Services*]).
  - Therefore, a minor in BC is legally prevented from refusing life-saving care. This is *not* to say that a minor is incapable of providing consent, or of refusing treatment that is not necessary to preserve life or to prevent serious injury. In such instances, it is likely that the doctrine of the mature minor still applies. Other jurisdictions may have their own, unique, legislative frameworks.

In general, a mature minor should be presumed capable. If the question of a mature minor's capacity to consent or to refuse consent becomes problematic, perhaps in light of life-threatening circumstances, the advice of child welfare authorities, hospital counsel, or the hospital ethicist should be sought.

Personal Directives and SDMs

Personal directives are mechanisms enabling a competent person to maintain control over clinical care in the event of future incapacity. A valid personal directive written by or on behalf of a previously capable individual must be obeyed.

Directives may be instructional, proxy, or combinations of the two (Table 2.9).

TAbLE 2.9 • Instructional Directives (Personal Directives) vs Proxy Directives (Subsitute Decision Makers)

	Instructional Directives	Proxy Directives
Mechanism	• Specify clinical interventions that should or not be undertaken in event of certain illnesses	• Appoint a competent individual to act as a decision maker on the patient's behalf • The proxy is normally bound to act on the basis of what the patient would have wanted
Comments	• Unable to anticipate all possible situations that may arise, and in that instructions may be too vague to be practicable	• Requires that the proxy be well informed in advance • The proxy's powers are not absolute. Physicians cannot legally comply if the proxy's decisions are unjustifiable (either by what the patient would have wanted or the best interests standard)
Example	• Use of a feeding tube under conditions of complete paralysis or severe dementia	• Patient's husband communicates a full code order based on prior discussions with his wife

LEGAL SYSTEM

Generally speaking, activities are governed by two sources of law: the law created by statute, either federally, provincially, or territorially, and the common law developed by judgments rendered in legal actions that have proceeded through the courts. Across Canada, except in Québec, common law is applicable. In Québec, the common law is replaced by general principles laid out in civil law. In most cases, the underlying principles of physician duties and patient rights are similar in common law provinces and territories.

Ethical and Legal Basis for Consent

Patient self-determination or autonomy is a fundamental right. This is recognized in common law, under which physicians find themselves liable for battery if they treat a patient without consent or for negligence if they treat a patient under inadequately formed consent and patient harm occurs as a result. Certain provinces have taken the further step of legislating consent. Ontario's *HCCA*, for example, "provides rules with respect to consent to treatment that apply consistently in all circumstances." Physician colleges also recognize a professional duty to seek consent. Failure to adequately uphold these norms could lead to professional disciplinary action, including suspension or loss of license.

NEGLIGENCE

Negligence is a private wrong involving an injury to person or property, and legal action can be taken. The usual remedy imposed by courts for physicians found liable for negligence is monetary compensation for damages and costs. Professional colleges may also suspend or revoke license to practice. This occurs separately from the negligence suit.

Negligence requires that the plaintiffs prove the existence of a duty of care, a breach of duty, causation, and consequent patient harm.

Duty of Care

- Duty of care arises from the doctor–patient relationship.
- Duty is also owed to third party in certain instances (e.g., There is a duty to disclose health information when maintenance of confidentiality would result in significant risk of substantial harm to others. *Tarasoff v. Regents*).
- Duty of care ends at the termination of the physician–patient relationship.

Standard of Care

When a duty of care is owed, the medical practitioner is bound to provide adequate care and to exercise the degree of care and skill that could reasonably be expected of a normal, prudent practitioner of the same experience and standing.

Standards of care are:

- Specific to the time of alleged negligence—it is recognized that medical knowledge changes quickly and standard of care is dynamic. The relevant standard is the set of expectations that existed at the time of the alleged negligence.
- Different for specialists and generalists—however, it should be noted that generalists performing procedures typically performed by specialists would be held to the specialist standard of care.
- Same for similar practitioners regardless of location—the rural ER doc is held to same standard as urban ER doc. And although physicians cannot be expected to provide services that are not locally available, there is a duty to disclose such services and how they might be accessed to the patient and to arrange for appropriate referral or transfer.

Duty to Rescue—The Emergency Situation

In the event of an emergency, a physician may be called upon to care for an individual with whom he or she has no patient–physician relationship. Whether or not Canadian law recognizes a duty of rescue, under which a physician-as-bystander would be obliged to act, is controversial. Nonetheless, if emergency care is provided, the provider may be obliged to exercise due diligence and to meet professional standards, to the extent that emergent circumstances make this possible. The physician may therefore owe a duty of care to the injured individual.

The Argument of Cost-Containment

In an era of health care reform, physicians may feel pressured to minimize referrals or transfers, or to reduce the utilization of expensive services. This pressure often relates to institutional cost-containment efforts. However, where medically appropriate services are available, physicians are required to disclose this fact, to discuss access with the patient, and to arrange access as appropriate, regardless of cost. Cost-containment is not a defense to negligence.

Breach of Duty

- It occurs when a medical provider makes an error or omission that no reasonable physician of similar training and experience would make under the circumstances.
- Not all errors are breaches of duty. Physicians are not infallible, and circumstances can prevent diagnostic or therapeutic success.
  - Errors in diagnosis and treatment, that is, errors of judgment, will occur. These errors may lead to significant harm, but do not constitute negligence if the standard of the reasonable practitioner is met.
  - However, what is initially an error of judgment may become a breach of duty (e.g., if medical staff members fail to reevaluate a misdiagnosis in light of nonresponse to treatment).
- Key question: Could a reasonable practitioner with appropriate training commit this error or omission? If no, then breach of duty has likely occurred.

Medical Errors

- Physician has an obligation to fully disclose any errors made in patient care.
- The most effective and responsible way to do this is to call the patient immediately, explain what happened, and apologize.

Causation and Injury

- A negligence suit requires that there be patient harm and that the harm occurred as a result of the breach of duty.
- If injury or causation cannot be established, damages will not be awarded.
- Recently, certain claims have made thorny issues of causation and injury.
  - Wrongful life suit—brought by parents, on behalf of a disabled child who is born, for example, as a result of a physician's failure to recommend genetic screening. If the physician had fulfilled the standard of care and recommended genetic screening, the disability may have been detected, the parents would have terminated the pregnancy, and the child would have been saved from the harm of a life of disability. Wrongful life suits have not been well received by Canadian courts: establishing injury on behalf of the child would require comparing the child's life to nonexistence.
  - Wrongful birth suit—brought on behalf of the parents and seeks compensation for costs and damages incurred in caring for the disabled child. Damages for the cost of raising the child have been awarded in such cases.

TRUTH TELLING

Ethical and Legal Considerations

- Truth telling is based on respect for patient autonomy and is important for physician–patient relationships.
- Physicians must speak truthfully and refrain from falsehood.
- Physicians must provide patients with important information, including:
  - Purpose and implications of investigations
  - Diagnosis and prognosis
  - Risks and benefits of treatment
  - Risks to which the patient may have been exposed
- Physicians must respect the patient's right to know **or not know**, seek consent for disclosure, and ascertain patient preferences. The decision to waive disclosure, if made voluntarily, is a valid decision and should be respected.
- Patients or their families will inevitably come to know information that was withheld or misrepresented.
- Legally, patients have rights of access and control over their health information.
- Failure to disclose health information that leads to patient harm may be construed as negligence.

Therapeutic Privilege

The doctrine of therapeutic privilege has been discredited except in extraordinary circumstances. Withholding or falsely representing health information has previously been justified under the physician's duty of beneficence. In invoking therapeutic privilege, the health information is said to be too complex, tragic, etc. for the patient to deal with. Therapeutic privilege presumes that the physician knows the patient's best interests better than the patient does. Therapeutic privilege may usefully be invoked where a significant risk of substantial harm accompanies honest disclosure. However, other ways of minimizing the risk of harm should be explored first, including emotional support and counseling. Of the situations remaining, those that truly require invoking therapeutic privilege will be extraordinary. Properly used, therapeutic privilege is a last resort.

CanMEDs suMMAry

PrOfEssiOnAL

self

1. Maintain competence
   a. Recognizing personal limits
   b. Continuing medical education
2. Personal health
   a. Work–life balance
   b. Self-respect
   c. Function without incapacity (e.g., drugs, ill health)

Patients and Family

1. Meet or exceed standards of care
2. Maintain continuity of care (e.g., following up on lab reports and consultations and appropriate transfer of care)
3. Maintain patient confidentiality
   a. Manage relationships between patients and family. Recognize there may be tension between interests, but the patient's concerns are primary
   b. Acknowledge limitations to confidentiality (e.g., mandatory reporting of child abuse, reportable infectious diseases, duty to warn)
   c. Recognize different attitudes regarding patient confidentiality (aboriginals, minors)
4. Manage the consent and capacity process
   a. Recognize when documentation of the process is necessary and when it is implied
   b. Correctly determine capacity. Capacity may be situation specific, and a patient who is capable for one decision may be incapable of making another.
   c. Principle of the reasonable person—"what would the reasonable person want to know?"
   d. Principle of full disclosure
5. Medical error and patient safety
   a. Timely, full and honest disclosure to patients and family

Society

1. Maintain competence, credentials, and licensure (to the requirements of your specialty)
2. Respect basic human rights (e.g., the rights to privacy, freedom from discrimination, autonomy)

Profession

1. Follow the rules, regulations, and ethical codes of the profession
2. Report a colleague's actions or behaviors as required or appropriate
3. Avoid situations where conflicts of interest may arise

Other Health Care Professionals and the Health Care System

1. Recognize the interdependence of HCPs, the differing scopes of practice, and the expertise of other health care providers
2. Know how to work in a team (e.g., respect one another, communicate effectively, resolve conflict, support team members, and be responsive to feedback)

Integrity

- Uphold the highest standards of integrity (including ethical conduct, honesty, compassion, and dedication to patients)
- Show expert communication skills (e.g., be watchful of own unconscious bias, be sensitive to differing views)
- Maintain appropriate and/or legal boundaries in relationships with patients and other HCPs and do not abuse power differentials
- Be a source of knowledge and/or skill by supporting and teaching whenever possible
- Understand and act appropriately in complex ethical situations
    - Physician-assisted suicide
    - Maternal–fetal conflict
    - Abortion
    - Advanced reproductive technology
    - Genetic testing and manipulation

Altruism

- Put the needs of others ahead of one's own and serve, when necessary, beyond normal duty or expectation. However, keep in mind personal/professional balance

COMMUNICATOR

Develop and Maintain Ethical Relationships

- Tailor interview to clinical context (e.g., ER vs. clinic) and use appropriate verbal/nonverbal communication
- Seek consent from competent patients before involving family
- Determine and document an appropriate substitute decision maker

Elicit Relevant Information from Patients and Families, Colleagues, and Other Professionals

- Use interviewing skills (e.g., active listening, clarification, summarizing)
- Obtain relevant information and seek additional information when necessary (with patient permission)

Convey Information

Convey relevant information and perspectives to patients and families

Develop a "Shared Plan of Care" with Patients, Families, and Other Professionals

- Negotiate an agreed upon course of action regarding investigations, management, and follow-up
- Communicate reasons for referral and the responsibilities of the consultant

Written Medical Information

- Maintain well-documented medical records and their confidentiality
- Allow patients access to records and give others access when given patient consent
- Write prescriptions legibly and correctly

Third Parties (e.g., Insurance Companies, Government)

- Disclose patient information only when legally allowed
- Be truthful and timely in communications
- Follow obligatory reporting standards (i.e., child abuse, reportable infectious diseases, duty to warn)

SCHOLAR

Personal Plan for Continuing Medical Education

- Principles of maintaining competence
- Self-awareness
- Ask for feedback from colleagues and supervisors
- Document the process

Apply Principles of Research and Information Management

- Apply principles of evidence-based research
- Seek appropriate resources—formulate a specific question, search the literature appropriately, and select the right resource
- Utilize skills of critical appraisal
- Apply principles of screening and evaluate the utility of a proposed screening intervention

Help Others Learn

- Disseminate new information to patients, HCPs, and society

MANAGER

Practice Management

- Logistical elements—finances, human resources
- Regulatory requirements (e.g., maintain patient records and prescription records, especially narcotics)
- Communicate practice information to patients (e.g., hours, contact information, service limitation)

Career Management

- Balance professional versus personal life and access supports if compromised

Allocate Health Care Resources Effectives

- With prudence and equality and without bias or discrimination
- Balance individual and societal needs

Understand the Health Care System as a Whole and the Role Physicians Play

- CHA
- Organization of the health care system (locally, provincially, and nationally)
- Roles and functions of physician advocacy groups, regulatory bodies, professional associations, and other organizations

COLLABORATOR

Within the Health Care System

- Recognize how organizations, policies, and finances impact care
- Work with external agencies (government, schools, NGOs, etc.) to address health at a population level
- Recognize services provided to special populations

With Consultants

This can be made into a diagram that outlines the process of the consultation and the important steps.

- Recognize needed expertise and triage based on urgency
- Identify correct consultant/service
- Communicate (verbal/written)
- Ensure appointment made
- Receive verbal/written report
- Carry out recommendations

Participate Effectively on Health Care Teams

- Understand scope of practice for each member and respect each other without bias
- Describe and adapt to differences in team organizations and functions
- Include the patient and family as a part of SDM

Manage Conflict Effectively

- Prevent conflict when able
- Negotiate and collaborate or use other strategies to deal with conflict
- Utilize the expertise of others when needing help in conflict resolution

HEALTH ADVOCATE

Identify the Important Determinants of Health

- Employment
- Income
- Social status
- Culture
- Social support systems
- Education
- Housing
- Diet and exercise
- Lifestyle issues
- Gender
- Genetics

Identify the Interaction

Identify the Interaction between the Population and their Physical, Biological, and Social Environments

Understand the Key Issues in the Canadian Health Care System

- Native health
- Rural versus urban divide/geography
- Safe injection sites
- Barriers to access for those with disabilities, the underserved, and the marginalized

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CHAPTER

3

Cardiology

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HYPERTENSION

MCC OBJECTIVE

Based on Objective #9-1 (Hypertension) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Definition

- An asymptomatic state of elevated arterial BP, which predisposes to cardiovascular diseases, including cerebrovascular/coronary/peripheral arterial disease, CHF, AF, CKD, erectile dysfunction, and dementia.
- Treatments aimed at reducing arterial BP have been shown to reduce the risk of CHF (50%), stroke (40%), and CAD (20%).

APPLIED SCIENTIFIC CONCEPT

Autoregulation

↑ CO →↑ MAP, detected by **aortic and carotid baroreceptors** → Vasodilation →↓ TPR and hence ↓ CO (to balance the initial ↑ CO)

Pressure Natriuresis

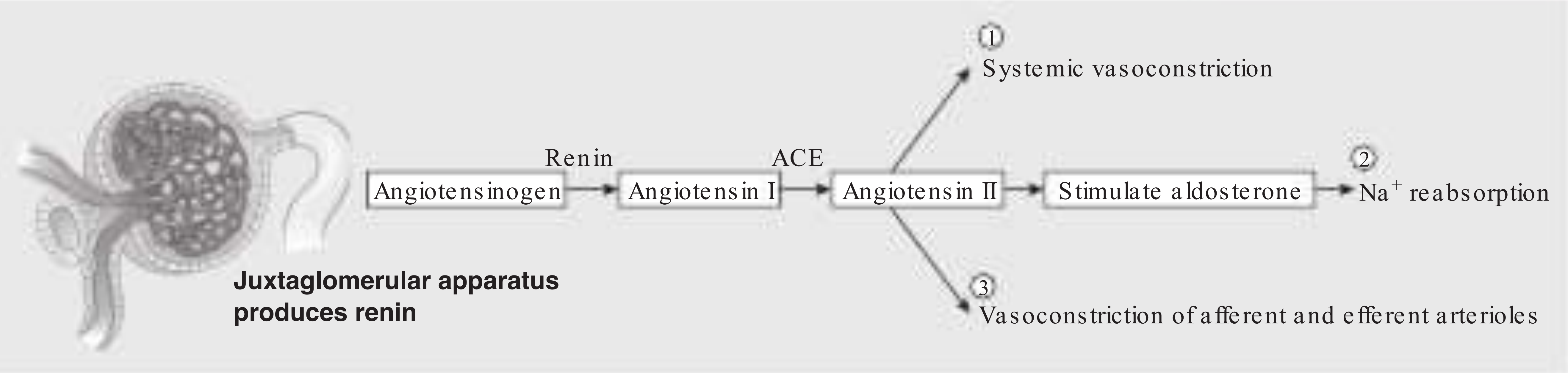
↑ MAP = ↑ **renal perfusion, ↑ GFR, and ↓ aldosterone** → ↑ Na + H_2O excretion (natriuresis)

ASC box

HTN

Effect of CO and SVR on BP:
CO = HR × SV MAP = TPR × CO
BP = CO × TPR CO = MAP/TPR
MAP = dBP + 1/3 pulse pressure

The Renin-Angiotensin-Aldosterone System (Figure 3.1)



①
Systemic vasoconstriction
Renin
ACE
Angiotensinogen
Angiotensin I
Angiotensin II
Stimulate aldosterone
②
Na+ reabsorption
③
Vasoconstriction of afferent and efferent arterioles
Juxtaglomerular apparatus produces renin

Figure 3.1. Renin-angiotensin-aldosterone system.

CAUSAL CONDITIONS

Essential HTN (>85%)

- Lifestyle factors: obesity, diet/Na^+ intake, sedentary lifestyle, excess EtOH, stress
- Medication factors: Rx drugs, OTC meds, and herbal products
- Family history/genetic factors

2° HTN

- Endocrine:
  - Aldosterone excess: primary adrenal hyperplasia (most common 2° cause), adrenal adenoma (Conn syndrome)
  - Glucocorticoid excess: Cushing syndrome, chronic steroid therapy
  - Hyperthyroidism
  - Hyperparathyroidism
  - Catecholamine excess (pheochromocytoma, rare)
- Chronic kidney disease (including polycystic kidney disease)
- Vascular:
  - Coarctation of the aorta
  - Renal artery stenosis (young—fibromuscular dysplasia, older pt—atherosclerotic)
- Obstructive sleep apnea

APPROACH

History

- Onset, duration
- Prior history or current symptoms of **end-organ damage**
- **Overall CV risk** assessment (dyslipidemia, smoking Hx, diabetes, family Hx of premature CAD)
- Symptoms of **hypertensive emergency** if severe HTN is present
- **Lifestyle** inquiry: recent weight gain, diet habits, EtOH intake, OSA symptoms
- **Medication** history (including prior Rx/side effects, OTC drugs, herbals) (Table 3.1)

TABLE 3.1 • Medications that may induce/aggravate HTN

NSAIDs	• Sympathomimetics • Decongestants—pseudoephedrine, phenylephrine, oxymetazoline • Cognitive stimulants—methylphenidate, dextroamphetamine • Midodrine • Illicit stimulants—cocaine
Corticosteroids	EPO and analogs
Exogenous androgens/estrogens (anabolic steroids, contraceptive agents)	Calcineurin inhibitors (cyclosporine, tacrolimus)
Licorice root (aldosterone-like effect)	Antidepressants • MAOIs—selegiline, phenelzine • SNRIs—bupropion • SSRIs

Physical Exam

- Careful BP measurement using the left arm (or highest of either arm if both are measured), at rest, with the arm horizontal, supported, and at the same vertical height as the heart. Legs should be uncrossed, and no food/nicotine/alcohol should be consumed within 30 min of BP measurement. Ensure that an appropriate-sized BP cuff is used (too small a cuff will overestimate BP).
- Arm circumference is measured at the mid-portion of the upper arm.
  - If arm circumference is 27 to 33 cm (10.5–13 in), usual adult cuff is appropriate.

  - If arm circumference is > 33 cm (13 in), large cuff is needed.
  - If arm circumference is > 44 cm (17.5 in), adult thigh cuff is needed.
- Systolic BP should first be estimated by inflating the cuff and palpating for the first appearance of the pulse. Next, the cuff should be inflated to > 30 mm Hg above the estimated SBP, and the brachial artery auscultated for the first appearance (first Korotkoff sound = systolic BP) and last appearance (fifth Korotkoff sound = diastolic BP) of repetitive, clear tapping sounds.
- Examine for **end-organ damage**: fundoscopy (copper wiring, cotton-wool spots, AV nicking, papilledema), signs of LVH (loud S_2, S_4, sustained apex beat), signs of CHF (elevated JVP, S_3, lung crackles, ascites, leg edema), peripheral vascular exam (pulsatile Abdo mass, absent peripheral pulses).
- Examine for **secondary HTN**: radial/femoral delay (coarctation of the aorta), signs of hyperthyroidism (tremor, diaphoresis, thyroid fullness/tenderness/nodules, thyroid stare/lid lag), Abdo mass (polycystic kidneys, large pheochromocytoma), Abdo bruits (renal artery stenosis), signs of Cushing disease (truncal obesity, striae, skin thinning/bruising).

Investigations

Routine Lab Testing

- Urinalysis and creatinine (looking for CKD)
- Electrolytes (Hypokalemia may suggest hyperaldosteronism)
- Fasting glucose and lipid profile (overall CV risk profile)
- 12-lead ECG (looking for evidence of LVH or prior MI)

Workup of 2° Causes (as Guided by Clinical and/or Laboratory Findings)

- **Endocrine:** TSH, PTH, 24-h urine for metanephrines, aldosterone, renin, aldosterone/renin ratio, 24-h urine-free cortisol, dexamethasone suppression test
- **CKD:** serum creatinine and estimated GFR
- **Vascular:**
  - Transthoracic echo, CT, or MR angiography (coarctation of the aorta)
  - Captopril renal scan, Abdo U/S with doppler, MRI (renal artery stenosis)
- **OSA:** sleep study

Diagnosis (2012 Canadian Hypertension Education Program [CHEP] Guidelines)

- A BP of > 140/90 mm Hg on three separate occasions. The use of at least one home, ambulatory, or 24-h BP measurement is recommended to avoid white coat HTN (HTN noted only in the physician's office, due to stress/anxiety) (Tables 3.2 and 3.3).

TABLE 3.2 • JNC classification of HTN

Category	Systolic (mm Hg)	Diastolic (mm Hg)
Normal	< 120	< 80
Pre-HTN	120–139	80–89
Stage 1 HTN	140–159	90–99
Stage 2 HTN	≥ 160	≥ 100

TABLE 3.3 • Classification of hypertension based on method of measurement

Method of BP Measurement	Elevated BP Cutoff
Office BP measurement	> 140/90
Ambulatory/home BP measurement	> 135/85
24-h average BP measurement	> 130/80

- If a history of target organ damage, kidney disease, or diabetes is present, a single measurement ≥ 140/90 is sufficient for diagnosis. A single measurement ≥ 180/90 also constitutes a diagnosis of HTN (see Table 3.4).

TABLE 3.4 • Target organ damage from HTN

Cerebrovascular disease (TIA, ischemic/hemorrhagic CVA, vascular dementia)
Hypertensive retinopathy
HF (LV hypertrophy, dysfunction)
Coronary artery disease (angina, MI)
Chronic kidney disease
Peripheral artery disease (claudication, erectile dysfunction)

Management

- Lifestyle measures are recommended for **all** pts with HTN (Table 3.5).

TABLE 3.5 • Impact of lifestyle measures on BP

Lifestyle Modification	Targeted Change
Sodium restriction	< 1.8 g/d
Weight loss	BMI < 25 kg/m^2, waist circumference • < 102 cm (men) • < 88 cm (women)
Alcohol reduction	< 2 drinks/d
Exercise—moderate intensity	4+ times/wk 120–150 min/wk
Dietary habits	DASH diet (high in vegetables, fruits, low-fat dairy, and low in total fat and saturated fat)

  - Dietary interventions have the most significant effect on BP, potentially decreasing it by up to −11/5 (SBP/dBP).
- Hypertensive pts receiving lifestyle modification advice alone should be followed up at least every 3 to 6 mo.
- Yearly follow-up is recommended for pts with high-normal (130/85–139/89) BP, as 30% to 40% will develop HTN in the next 3 yr.
- Treatment target is < **140/90 (or < 135/85 for ambulatory BP measurements) for all pts** (**except for diabetics**, who should be treated to < **130/80**—ACCORD BP trial).

Pharmacologic Therapy

- Antihypertensive therapy should be prescribed when average BP is > 160/100 or > 140/90 with evidence of target organ damage, regardless of age.
- Consider using single-pill combination agents to improve compliance, especially when average SBP is 20 mm Hg above target.
- Choice of first-line agent:
  - Thiazide diuretics, ACEIs/ARBs (in non-Black pts), long-acting CCBs, and b-blockers (in pts < 60 yr of age) are reasonable first-line agents, if no comorbidities are present that warrant a specific drug class (see Table 3.6).

TABLE 3.6 • Antihypertensives advised for pts with select comorbidities

Condition	Antihypertensives
Diabetes mellitus	ACEI or ARB
Asthma	CCB (nondihydropyridine)
Prior MI	ACEI, b-blocker
Angina	b-blocker, long-acting CCB
CKD	ACEI, ARB (with caution)
CHF	ACEI, b-blocker, aldosterone antagonist
Migraines	b-blocker, long-acting CCB
Raynaud, coronary spasm	Long-acting CCB

- Pts should be followed up every 1 to 2 mo to monitor treatment efficacy and side effects (Table 3.7). If a second or third agent is required, an additional agent considered "first line" may be added. Once BP is at target on two separate occasions, follow-up may be extended to every 3 to 6 mo.

TABLE 3.7 • Common side effects of antihypertensive agents

Antihypertensive Class	Side Effects
All agents	Hypotension, especially postural
ACEI	Dry cough (10%)—bradykinin related
ACEI, ARB, Aldo antagonists	Hyperkalemia
Thiazide diuretics	Hypokalemia, muscle cramps, tachyarrhythmias
β-Blockers	Depression, fatigue, impotence, bradyarrhythmias
Non-DHP CCBs (diltiazem)	Bradycardia
DHP CCBs	Leg edema, GERD

HYPERTENSIVE CRISES: EMERGENCIES AND URGENCIES

MCC OBJECTIVE

Based on Objective #9-1 (Hypertension) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Definition

- **Hypertensive urgency** is defined by a severely elevated BP (> 180/120 mm Hg), without progressive target organ dysfunction.
- **Hypertensive emergency** is defined by a severely elevated BP *plus* evidence of impending or progressive target organ dysfunction. **These pts require immediate BP reduction to prevent or limit target organ damage.**

APPLIED SCIENTIFIC CONCEPT

Mechanism of Vascular Injury

- Mild to moderate ↑ in BP → arterial and arteriolar **vasoconstriction**. This maintains tissue perfusion at a relatively constant level and prevents pressure from being transferred to smaller, more distal vessels.
- However, with ↑ severe HTN → autoregulation fails → ↑ in arteriole and capillary pressure → damage to vascular wall, disruption of endothelium (**breakthrough vasodilation**).
- Endothelial damage → leakage of plasma constituents → obliteration of vascular endothelial lumen.
- Role of renin-angiotensin ↑ BP → natriuresis + renal vascular injury → ↑ renin which ↑ angiotensin II → exacerbating HTN.

Hypertensive medication can cause the BP autoregulation curve to shift and respond at lower BP. This can result in ischemic damage.

Autoregulation → arterial and arteriole vasodilation → tissue perfusion maintained during Rx of HTN

$$Q = P/R$$

A parallel ↓ in both P and R will maintain Q. But when ↓ P (due to excessive response to Rx) while R maintains the same → ↓ flow → ischemia

CAUSAL CONDITIONS

- **Severe essential HTN:** typically with medication noncompliance or acute drug withdrawal (most common)

- **Secondary causes:** acute renal failure (acute GN, scleroderma crisis), renovascular HTN (often presents with acute CHF and HTN), thyrotoxicosis, medication-related (cocaine, MAOI + tyramine-containing food), advanced CKD with volume overload, pheochromocytoma, pregnancy-associated

APPROACH

History

- Symptoms of hypertensive emergency (in addition to usual *HTN* history):
  - Encephalopathy (headache, altered LOC, acute neurologic deficits)
  - Aortic dissection (sudden severe tearing chest/back pain)
  - CHF (orthopnea, paroxysmal nocturnal dyspnea, ascites, leg edema)
  - Myocardial ischemia/infarction (chest heaviness/pressure, shortness of breath)
  - Acute/progressive renal failure (oliguria)
  - Eclampsia (hyperreflexia, clonus, seizures)

Physical Exam

- Signs of hypertensive emergency:
  - **Vitals**: HR, O_2 sat, RR, and blood measurement in both arms. A new arm–arm difference > 20/10 mm Hg suggests aortic dissection. The highest BP is assumed to be most accurate.
  - **CNS**: LOC, fundoscopy (for papilledema), focused neurologic exam (for new deficits or preeclampsia/hyperreflexia/clonus).
  - **CVS/Resp**: signs of HF (elevated JVP, S_3, lung crackles, leg edema), signs of acute myocardial ischemia (new holosystolic murmur, new S_4).

Investigations

- Look for evidence of target organ dysfunction/injury:
  - Routine labs (CBC, electrolytes, urea, creatinine, urinalysis, troponin, urinalysis, liver enzymes), CXR and ECG to look for acute renal injury, myocardial ischemia/infarction, and/or congestive HF
  - CT head if signs/symptoms of hypertensive encephalopathy/stroke
  - CT angio or TEE if signs/symptoms of aortic dissection
- Lab testing for secondary causes of HTN:
  - Toxicology, TSH, urine for metanephrines, b-hCG—as dictated by clinical situation

Management

- First step is to distinguish whether you are dealing with hypertensive urgency (**no** target organ injury) or emergency (target organ injury is **present**).
  - There is no evidence to suggest that failure to aggressively lower the BP in severe uncontrolled HTN (hypertensive urgency) is associated with increased short-term risk—in fact aggressive dosing with IV or PO drugs can precipitate transient hypoperfusion (due to altered autoregulation) and postural hypotension with resulting injury.
- In hypertensive emergency, pts must be admitted to an ICU for continuous BP monitoring and urgent IV antihypertensive therapy (see Table 3.8). BP should be urgently (≤ 60 min) reduced by 25%, but should be gradually lowered thereafter. Excessive, sudden falls in BP can lead to organ hypoperfusion and should be avoided. A target BP of 160/100 for the initial 6 to 24 h followed by the gradual addition of oral agents (and withdrawing IV agents as needed) is a reasonable approach.

TABLE 3.8 • IV antihypertensives in hypertensive emergency

Adrenergic Blocker	Special Indications
Labetalol	First line in most cases, except CHF
Vasodilators	
Nitroprusside	Many hypertensive emergencies Caution in CKD and increased ICP
Nitroglycerine	Use in coronary ischemia and HF
Hydralazine	Eclampsia

PREGNANCY-ASSOCIATED HYPERTENSION

MCC OBJECTIVE

Based on Objective #9-1-4 (Hypertensive Disorders of Pregnancy) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- 10% to 20% of pregnancies are associated with HTN (~6% chronic HTN, 6% preeclampsia, 6% gestational HTN) (Table 3.9).

TABLE 3.9 • Classification of HTN in pregnancy

Chronic HTN	• **Prior** to pregnancy • **Before** 20 wk GA • **Persists** > 12 wk postpartum
Gestational HTN	• **New** onset HTN **after** 20 wk GA • **Without** proteinuria
Preeclampsia	• **New HTN** • **Proteinuria** (> 300 mg/24 h) after 20 wk GA
Chronic HTN with superimposed preeclampsia	• **New** (or 2–3 × increase in) **proteinuria, thrombocytopenia, elevated AST/ALT after 20 wk** • In women with **preexisting** HTN **before 20 wk** GA
Transient HTN	• Postpartum **return to normal BP** by **12 wk** postpartum • Increased risk of HTN in future pregnancies

APPLIED SCIENTIFIC CONCEPT

ASC box

Pregnancy-Associated HTN

- The earliest pathologic Δ that happens in preeclampsia occurs in uteroplacental circulation.
- In preeclampsia, cytotrophoblast fails to invade the myometrial portion of uterus.
- The large tortuous vascular channels do not develop, and vessels narrow leading to placental hypoperfusion.
- This results in Δs in uteroplacental circulation (impaired trophoblast invasion and placental ischemia) that occurs in preeclampsia.
- Chronologic Δs resulting from placental ischemia are as follows:
  - As pregnancy progresses → AbN uterine vasculature → placental hypoperfusion
  - Late placental Δs 2° to hypoperfusion → atherosis, arteriole sclerotic narrowing, thrombosis, fibrinoid necrosis, infarction of placenta
  - Ischemic placenta → release of proinflammatory cytokines and mediators of oxidative stress in maternal bloodstream → ↑ capillary permeability as well as activation of endothelial cells and coagulation system. The key player in pathogenesis of preeclampsia appears to be sVEGFR-1, an antagonist of PGF and VEGF.

APPROACH

Goals

- Differentiate preeclampsia from other HTN states in pregnancy
- Determine severity of HTN
- Preserve fetal well-being by assessment/monitoring

History

- Gestational age
- Symptoms of preeclampsia:
  - Visual disturbance
  - New onset headache

  - Epigastric or RUQ pain
  - Rapidly progressing peripheral edema
  - Rapid weight gain
- Medical history:
  - Preexisting HTN
  - Previous episodes of preeclampsia/eclampsia
  - HTN during previous pregnancies
  - Family history of preeclampsia/eclampsia

Physical Exam

- Signs of preeclampsia:
  - **Vitals**: rollover test (≥ 15 mm Hg rise in diastolic BP with rollover from left lateral decubitus to supine position is positive)
  - **CNS**: LOC, fundoscopy (for papilledema), focused neurologic exam (hyperreflexia/clonus)
  - **Abdo**: signs of HF (elevated JVP, S_3, lung crackles, leg edema), signs of acute myocardial ischemia (new holosystolic murmur, new S_4)
- Signs of chronic HTN/target organ damage (see *Systemic Hypertension* section)

Investigations

- Lab testing for proteinuria, signs of severe preeclampsia (Table 3.10)

TABLE 3.10 • Laboratory testing in pregnancy-associated HTN

Urinalysis: 24-h urine for protein, urine dip	≥ 300 mg/d	Preeclampsia
CBC + peripheral blood smear, Hgb, **LDH**, haptoglobin	Anemia, with schistocytes, elevated LDH, and low haptoglobin	Hemolysis from severe preeclampsia
Platelet count	Low	Severe preeclampsia
Creatinine, uric acid	Elevated	Severe preeclampsia
AST, ALT	Elevated	Severe preeclampsia
PT, PTT, fibrinogen	Elevated PT, PTT, and low fibrinogen	Severe preeclampsia, resulting in DIC

Bolded tests are routinely performed.

- Assess fetal well-being:
  - Nonstress test or biophysical profile in late pregnancy to evaluate growth/amniotic fluid volume

Management

- The aim is to avoid maternal complications and fetal complications (Tables 3.11 and 3.12)

TABLE 3.11 • Treatment choices in chronic HTN in pregnancy

HTN of Any Etiology	Bed Rest: Largely Recommended, but No Large Trials to Support Efficacy
Chronic HTN	1. **Antihypertensives**—should be **reviewed/stopped** (ACEI/ARBs/Aldo antagonists contraindicated) **prior to** pregnancy. If BP > 160/110, multiple agents needed prenatally, or target organ damage present, antihypertensives (Table 3.13) should be initiated/continued
Gestational HTN	1. **Antihypertensives**—recommended only if BP > 160/110. Labetalol, hydralazine, and/or CCBs (nifedipine) are reasonable options (IV if delivery within < 48 h) 2. **Fetal well-being**—biophysical profile (BPP) when HTN diagnosed, and then at least every 4 wk 3. **Delivery**—indicated if near term. No later than 40 wk

(Continued)

TABLE 3.11 • Continued

Preeclampsia	1. **Delivery**—preeclampsia in most cases worsens over time, and delivery is the definitive treatment (in severe preeclampsia, delivery indicated regardless of GA) 2. **Fetal well-being/lung maturity**—betamethasone 12 mg IM × 2 doses given 24 h apart given for women < 34 wk GA 3. **Anticonvulsant therapy**—given during labor, planned delivery (via prostaglandin administration) or corticosteroid administration; magnesium sulfate 4–6 g IV over 20 min, then 2 g/h continuous infusion[a] 4. **Antihypertensives**—generally avoided; does not improve perinatal outcomes and may alter uteroplacental blood flow. May be considered for maternal safety in severe HTN

[a] Women on high-dose magnesium Sulfate should be monitored for magnesium toxicity (loss of deep tendon reflexes).

TABLE 3.12 • Medication choices in chronic HTN in pregnancy

b-Blocker: **labetalol**	• Reduced side effect when compared to methyldopa • Increasingly preferred over methyldopa • Other b-blockers are generally safe **except** atenolol
Methyldopa	• Mild antihypertensive, may not achieve BP goals • Widely used long-term follow-up data support safety • Side effects are common (depression/sedation)
ACEIs, ARBs, aldosterone antagonists	• **Contraindicated**—reports of fetal renal abnormalities and death

HEART FAILURE

MCC OBJECTIVE

Based on Objective #29-1 (Generalized Edema) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Definition

- The inability of the heart to supply the circulatory needs of the body or the ability to do so only at higher than normal filing pressures

Classifying HF

- Systolic versus diastolic HF—low LV ejection fraction in systolic HF
- Low output versus high output—low BP, organ hypoperfusion in low output (Figure 3.2)

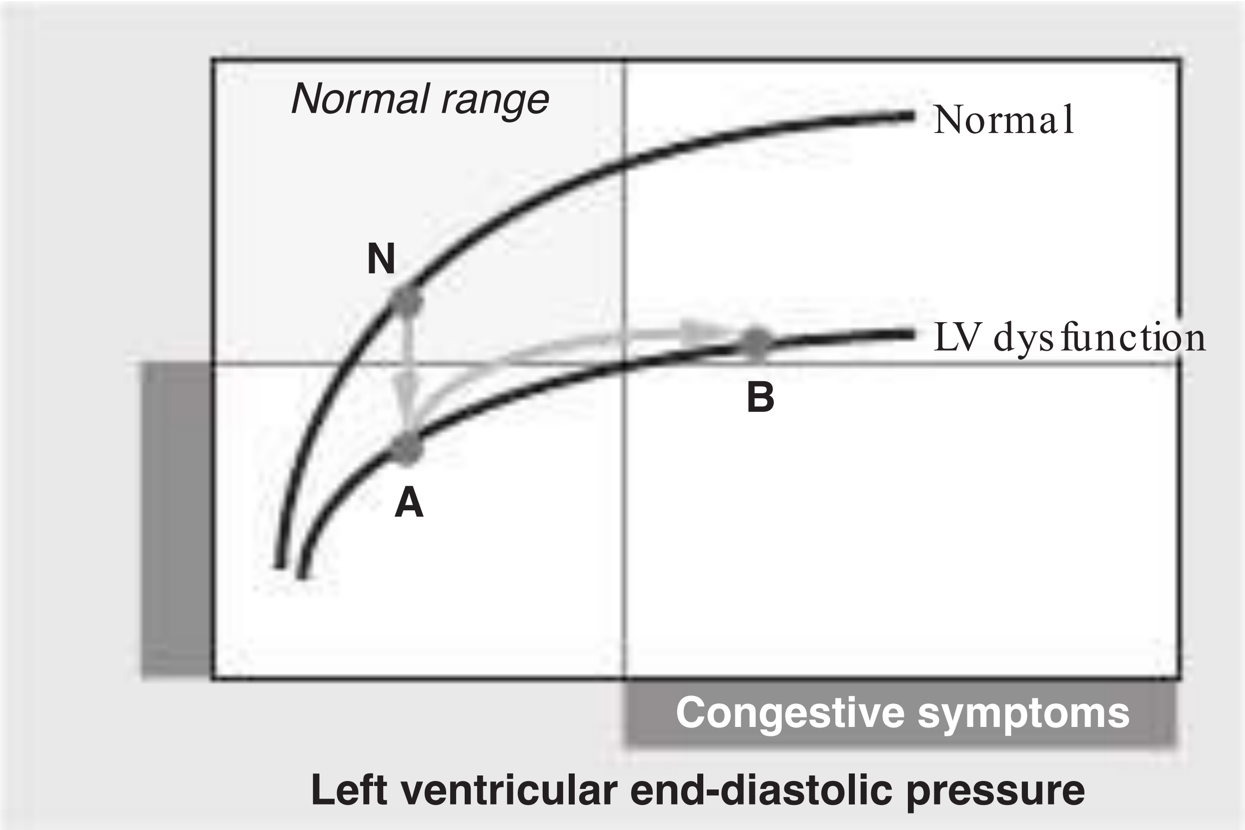


Figure 3.2. The relationship between cardiac output and left ventricular end-diastolic pressure.

- Congestive versus dry—pulmonary edema, orthopnea, ascites, leg edema in congestive
- Left-sided versus right-sided—pulm edema in left-sided, ascites, leg edema in right-sided
- Acute decompensated versus chronic—rapid (< 2 wk) symptom progression in acute

epidemiology

- Over 300,000 Canadians suffer from HF
- Overall mortality at 1 yr is > 30%
  - 40% from arrhythmia
  - 40% from worsening HF
  - 20% from other causes
- Readmission rate at 1 yr is > 20%

Etiology

- Ischemic (prior MI or severe CAD) (most common cause)
- HTN (second most common cause)
- Valvular heart disease
- Cardiomyopathy (intrinsic heart muscle disorder)—dilated, hypertrophic, restrictive
  - Primary—genetic/idiopathic
  - Secondary—alcohol, uncontrolled tachycardia, medications (anthracyclines, trastuzumab, stimulants), connective tissue disease (systemic lupus erythematosis), sarcoid, amyloid, hemochromatosis, severe hypo/hyperthyroidism
- Complex congenital heart disease

APPROACH

History

- Symptoms of HF:
  - Breathlessness
  - Fatigue
  - Orthopnea
  - Paroxysmal nocturnal dyspnea
  - Peripheral edema (leg edema, ascites)
- Medical history and CAD risk factors:
  - History of cardiac disease: prior MI, angina, palpitations/arrhythmia (atrial fibrillation), heart murmur/valvular heart disease, rheumatic fever
  - CAD risk factors: HTN, dyslipidemia, diabetes, smoking, family history of CAD
  - Alcohol intake (frequency/amount)
  - History of lupus, sarcoid, amyloid, hemochromatosis
  - Prior history of cancer and exposure to chemotherapy

Physical Exam

- Signs of HF:
  - **Vitals**: HR and rhythm (sinus vs. Afib), BP (narrow pulse pressure if low output), O_2 sat, RR
  - **CVS**: low central pulse (carotid) volume, elevated JVP, S_3 (volume overload) or S_4 (pressure overload), murmurs, sustained/displaced apex beat
  - **Resp**: lung crackles (pulm edema), dullness to percussion at bases (pleural effusions)
  - **Abdo**: signs of ascites (flank dullness, shifting dullness, fluid wave test)
  - **Peripheral**: cool extremities (if low output), pitting leg edema (if congested)
- Signs of secondary causes of HF: skin/eyelid rashes or bronzing, (lupus, sarcoid, amyloid, hemochromatosis), signs of hyperthyroidism (tremors, diaphoresis, lid lag, thyroid stare, hyperreflexia), signs of hypothyroidism (dry skin, pretibial myxedema, abnormal reflexes with slow relaxation phase)

Investigations

- Lab testing (CBC, electrolytes, creatinine, transferrin saturation [serum iron/TIBC], ferritin, TSH)
- ECG (look for LBBB, LVH/RVH, atrial enlargement, Q waves, ST changes)
- Chest x-ray (cardiomegaly, pulmonary edema, pleural effusion)
- Transthoracic echocardiogram (LV systolic function, RV function, valves)
- B-type natriuretic peptide (BNP) or NT-proBNP if available (BNP > 500 pg/mL or NT-proBNP > 900 pg/mL suggests HF)

Management

- *General measures:* O_2, IV access, cardiac monitoring, ABG, intubation/BiPAP if in extremis
- **Acute decompensated HF** treatments tailored to presenting hemodynamic profile:
  - Wet and warm (most common)—diuretics, vasodilators (IV nitroglycerin or nitropatch)
  - Dry and warm (well compensated)—optimize chronic HF therapies (incl BB)
  - Dry and cold (over diuresis)—reduce/hold diuretic, careful volume replacement
  - Wet and cold (advanced HF)—inotropes required. Consider invasive hemodynamic monitoring (PA catheter), philosophy of care, transplant assessment (see Figure 3.3)

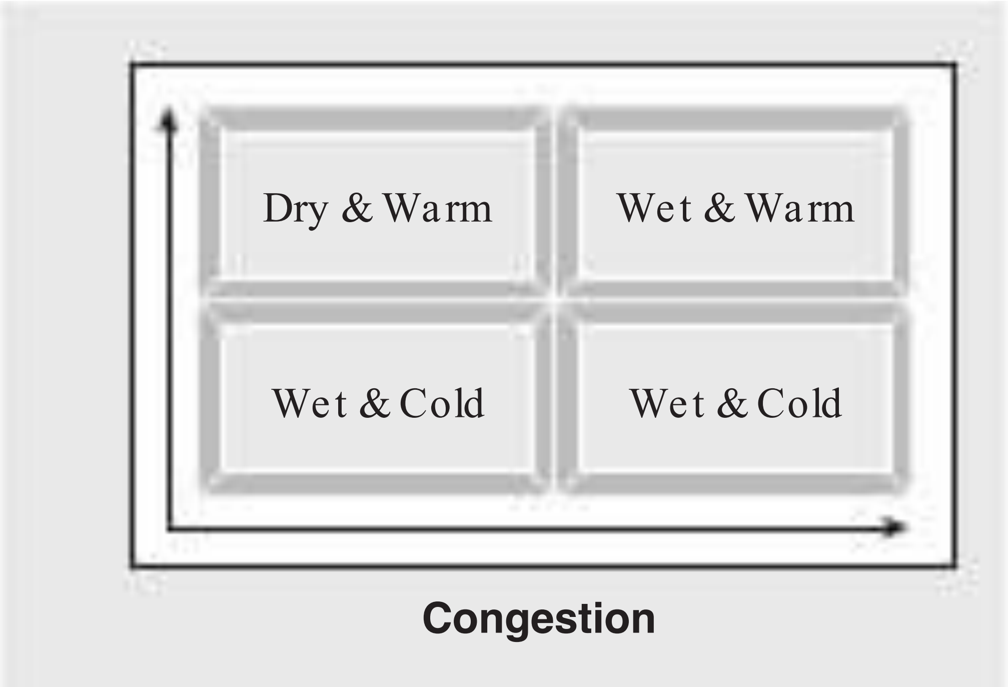


Figure 3.3. Relationship between perfusion and congestion.

- **Chronic HF** treatments:
  - Life-prolonging drug therapies (should be titrated to maximum tolerable dose) (see Table 3.13):

TABLE 3.13 • Drug choices in chronic HF

Drug				
ACEIs	a -Blockers	Aldosterone Antagonists	ARBs	Other Vasodilators
Enalapril	Bisoprolol	Spironolactone	Candesartan	Hydralazine
Lisinopril	Carvedilol	Eplerenone	Valsartan	
Perindopril	Metoprolol			
Ramipril				

    - **ACEI** if LVEF < 40% (ARB if ACEI intolerant; hydralazine/isosorbide dinitrate [vasodilators] if ACEI/ARB intolerant)
    - b-**Blocker** if LVEF < 40%
    - **Aldosterone antagonist** (spironolactone/eplerenone) if NYHA II-IV symptoms, LVEF < 35% (see NYHA Clinical Box)
  - Life-prolonging device therapies (consider when LVEF < 35% despite medical therapies):
    - **Cardiac Resynchronization Therapy**—for prolonged QRS
    - **Implantable Cardioverter Defibrillator**
- Adjuncts to above treatments:
  - Optimize volume status with tailored diuretic therapy
  - Digoxin may be considered if symptoms persist despite above therapies
  - Treat all CAD risk factors → (HTN, dyslipidemia, diabetes, smoking)
  - Provide HF teaching (including sodium/stimulant/alcohol avoidance, self-monitoring with daily weights, importance of medications, prognosis)
  - Vaccinate—yearly influenza vaccination and q5 yearly *S. pneumoniae* vaccination

CLINICAL box

The NYHA functional classification is used to classify the extent of HF in pts based on:

1. Limitation to physical activity
2. Degree of comfort at rest
3. Symptoms with ordinary physical activity

Class	Limitation to Physical Activity	Degree of Comfort at Rest	Symptoms with Ordinary Physical Activity
I	No limitation	Comfortable	No undue fatigue, palpitation, dyspnea, or anginal pain
II	Slight limitation	Comfortable	Fatigue, palpation, dyspnea, or anginal pain
III	Marked limitation	Comfortable	Fatigue, palpation, dyspnea, or anginal pain with less than ordinary activity
IV	Pronounced limitation	Symptoms of HF or angina syndrome	Discomfort with any physical activity

The Criteria Committee of the New York Heart Association. Nomenclature and Criteria for Diagnosis of Diseases of the Heart and Great Vessels. 9th ed. Boston, MA: Little Brown & Company; 1994:253–256.

HYPOTENSION

MCC OBJECTIVE

Based on Objective #9-2 (Hypotension, Shock) of *Objectives for the Qualifying Examination*, 3rd edition.

ASC box

Hypotension

Biochemical process derangement in prolonged, severe shock:

1. Ion pump dysfunction across cellular membrane
2. Intracellular edema
3. Intracellular contents leaking into extracellular space
4. Intracellular pH derangement

OVERVIEW

Definition

- A physiologic state of overwhelming reduction in systemic tissue perfusion leading to a a change in tissue oxygenation

APPLIED SCIENTIFIC CONCEPT

Effects of reduced tissue perfusion are **reversible at the early stage**. Prolonged, severe hypotension on systemic tissue perfusion → ↓ O_2 delivery → cellular deprivation → cellular hypoxia

CAUSAL CONDITIONS (Figure 3.4)

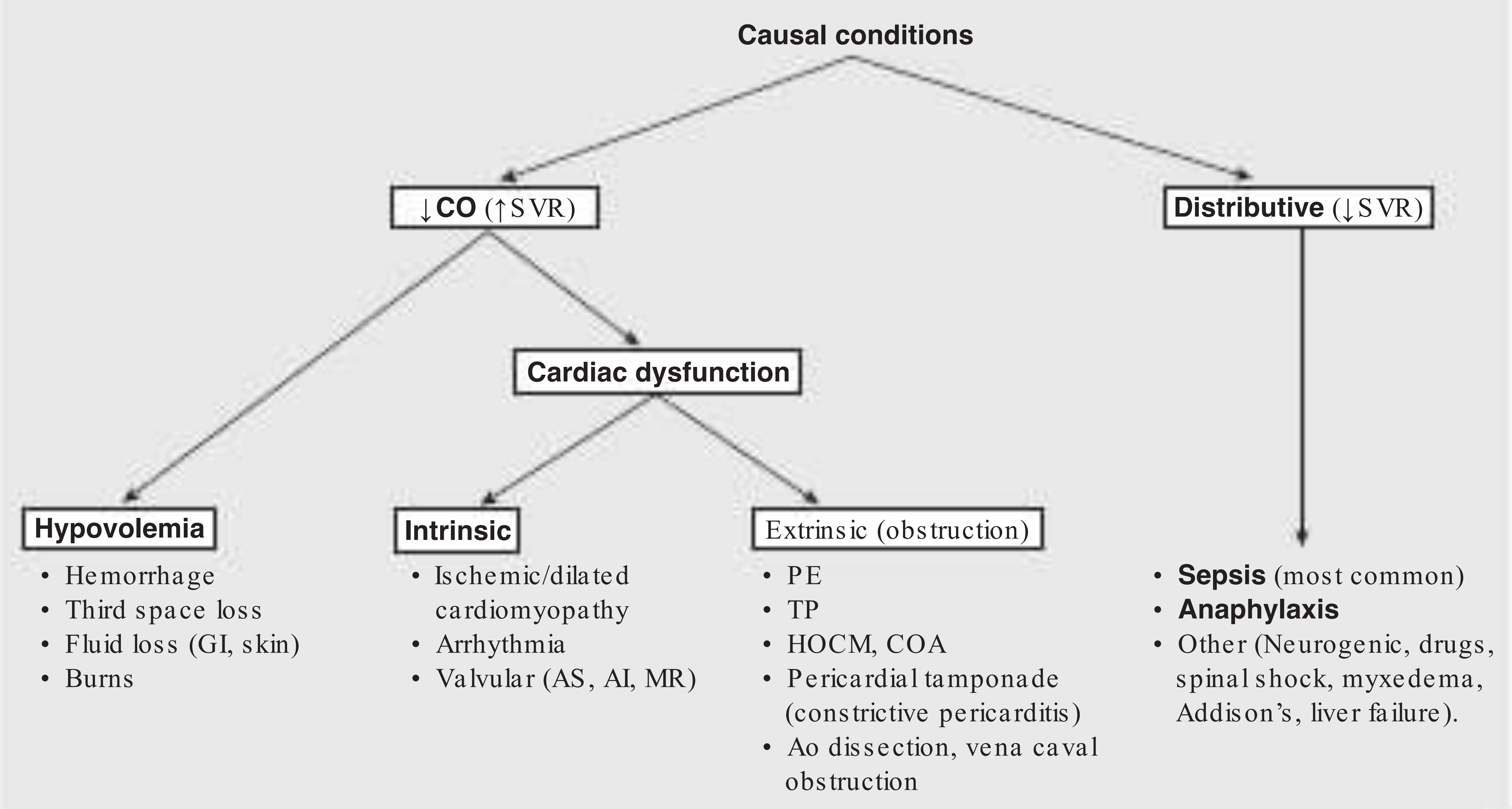


Figure 3.4. Causal conditions of hypotension.

Approach

History

- Obtain collateral Hx from relatives' medical records. Recent complaints/activities, allergies, changes in medications, drug intoxication, premorbid illnesses

Physical Exam

- Assess **ABC**. Examine swiftly for (a) volume status; (b) meningeal signs; (c) absent breath sounds/crackles, consolidation; (d) heart arrhythmia, murmurs, rubs; (e) Abdo tenderness, bowel sounds, ascites/distension, masses, rectal bleeding; (f) swollen calf; (g) cold/hyperemic skin, rash; and (h) check for muffled heart sounds, jugular venous distention, hypotension (Beck triad), and pulses paradoxus, suggesting cardiac tamponade

Management

- Workup:
  - CBC, electrolytes, LFT, CR clearance, amylase/lipase, fibrinogen degradation product, lactate, cardiac enzymes, ABG, toxicology, CXR, ECHO, EKG, troponin, pro-BNP, U/A. Continuous monitoring is required to assess response to Rx
- Acute treatment:
  - Stabilize the pt: ABC—airway, 100% O_2, two large-bore IVs, and Trendelenburg position (increase venous return, cerebral perfusion)
  - Monitors: automatic BP, pulse oximetry, cardiac monitoring
  - Diagnose cause of shock based on signs and symptoms in Table 3.14 and manage accordingly
  - Consider ICU admission if IV vasopressors are needed or refractory hypotension

CLINICAL box

Five common Features of Shock

1. Hypotension, either SBP < 90 mm Hg or a drop of > 40 mm Hg in SBP
2. Cool, clammy skin (except for distributive shock → warm, dry skin)
3. Oliguria (< 0.5 mL/kg/h)
4. Δ in mental status (agitation → confusion → obtundation)
5. Metabolic acidosis

Other findings: tachycardia, orthostatic hypotension, poor skin turgor, ↓ sweat, dry mucous membrane (see Table 3.14)

TABLE 3.14 • Findings in different states of shock

Findings	Hypovolemic	Cardiogenic	Distributive
HEENT	Dry conjunctivae and mucous membrane	Scleral icterus (MAHA from mechanical valve, CHF → nutmeg liver)	Flushy/swollen face, angioedema (swelling of lips and tongue)
JVP, carotid pulse	↓ JVP	↑ JVP, pulsus parvus et tardus (AS)	↓ JVP, delayed carotid, meningeal sign
Heart	Tachycardia	Arrhythmia, tachycardia/bradycardia, S_3 gallop, ventricular heave, murmurs, rub, distant heart sounds, pulsus paradoxus	Tachycardia
Lungs	Tachypnea, Kussmaul breathing	Crackles (CHF), absent breath sounds, rub	Shallow breaths
Abdo	Tenderness, distention, absence of bowel sounds, pulsatile masses	Distended (hepatic congestion from CHF)	Tenderness, distension, rebound tenderness, absent bowel sounds, pulsatile masses
Skin	Cold, clammy	Cold, clammy/warm hyperemic skin	Warm, hyperemic, rashes, petechiae, urticarial, cellulitis
Neuro	Agitation, confusion, delirium, obtundation, coma	Agitation, confusion, delirium, obtundation, coma	Agitation, confusion, delirium, obtundation, coma, spinal cord injury
Rectal	Bright red blood, melena, occult blood in stool	Hemorrhoids	↓ anal tone (spinal cord injury)
Ix	CBC, electrolytes, BUN, Cr, amylase, lipase, lactate, Abdo x-ray, U/A	CBC, electrolytes, BUN, Cr, D-dimer, cardiac enzymes, ABG, toxicology screen, CXR, EKG, PCWP in ICU	CBC with differentials, electrolytes, lactate, toxicology screen, amylase, lipase, blood culture, spinal XR, EKG, ECHO, cardiac enzymes, TSH, procalcitonin
Causes	Hemorrhage, third space loss, GI fluid loss	Ischemic/dilated cardiomyopathy, arrhythmia, mechanical (valvular, i.e., AS), PE, TP, tamponade	Sepsis, anaphylaxis, neurogenic, spinal shock

CLINICAL box

Physiologic Variables in Different States of Shock

Physiologic Variables	Preload	Pump Function	Afterload	Tissue Perfusion
Clinical measurement	PCWP	CO	SVR	Mixed venous O_2 saturation
Hypovolemic	↓	↓	↑	↓
Cardiogenic	↑	↓	↑	↓
Distributive	↓ or ←→	↑	↓	↑

- Hypovolemic shock:
  - Rapid volume repletion
  - For hypovolemic nonhemorrhagic shock:
    - Give crystalloids (0.9% N/S or Ringer lactate) 1 to 2 L IV bolus, then replace fluid accordingly to maintain SBP > 90 mm Hg or minimum MAP of 60, urine output > 0.5 mL/kg/h
  - For hypovolemic hemorrhagic shock:
    - Cross match and transfuse in addition to giving crystalloid. Maintain hemoglobin > 80 to 90 g/L (Hct 30%–35%), if Hx of cardiac disease or acutely bleeding. Control bleeding.
    - In cases of massive transfusion, watch for acidosis, hypothermia, hypocalcemia
- Distributive shock:
- Septic shock early goal-directed therapy
  - Rapid volume repletion: give 2 to 6 L crystalloid/colloid (target CVP 8–12 mm Hg)
  - Achieve adequate BP: use vasoactive agents (target SBP > 90 mm Hg, MAP > 65 mm Hg)
  - Ensure organ perfusion: transfuse RBCs, use inotropes as needed (target $Scvo_2$ > 70%)
  - Empiric, broad-spectrum antibiotics ASAP (after collecting blood cultures)—pip/tazo, imipenem, consider recombinant activated protein C—controversial
- Neurogenic shock:
  - Load methylprednisolone 30 mg/kg over 15 min, then infuse 5.4 mg/kg/h for next 24 h
- Anaphylactic shock (see Anaphylaxis section)
- Cardiogenic shock:
  - Treat underlying cause (ACS, valvular stenosis/insufficiency, acute decompensated HF)
  - Assess/optimize volume status (diuretics for overload, fluids for volume contraction)
  - If hypotension persists, support BP with vasopressors (dopamine)
  - Consider carefully adding/substituting inotropes for hypoperfusion (may decrease BP)
  - Treat any arrhythmias which may be contributing to shock (i.e., atrial fibrillation) (Table 3.15)

TAbl E 3.15 • Commonly used vasopressors and inotropes for shock

Agent	Dose	CO	SVR	HR	Mechanism of Action
Vasopressors					
Norepinephrine	5–20 mg/min	+	+ + +	+	Strong a adrenergic agonist, mild b_1 adrenergic activity also
Dopamine	2–20 mg/kg/min	+ +	+ + + (may decrease SVR at low doses)	+ + +	Dopamine agonist (at low dose) and b_1 agonist (at intermediate-high doses)
Phenylephrine	1–10 mg/kg/min	–	+ + +	–	Pure a adrenergic agonist
Vasopressin	0.2–0.4 U/min	–	+ +	–	ADH analog—vasoconstrictive effect
Epinephrine	1–10 mg/kg/min	+ + +	+ + +	+ + +	a + b adrenergic agonist
Inotropes					
Dobutamine	2–20 mg/kg/min	+ + +	–	+ +	Strong b_1 adrenergic agonist
Milrinone	0.25–0.5 mg/kg/min	+ + +	(Decrease)	+	Phosphodiesterase (PD3) inhibitor, with positive inotropic and vasodilatory action

ANAPHYLAXIS

MCC OBJECTIVE

Based on Objective #9-2 (Hypotension, Shock) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Definition

- Anaphylaxis is an IgE-mediated, immediate hypersensitive allergic reaction to protein substances. In Canada, anaphylaxis causes approximately 50 fatalities/yr and 1/5,000 admissions.

APPLIED SCIENTIFIC CONCEPT

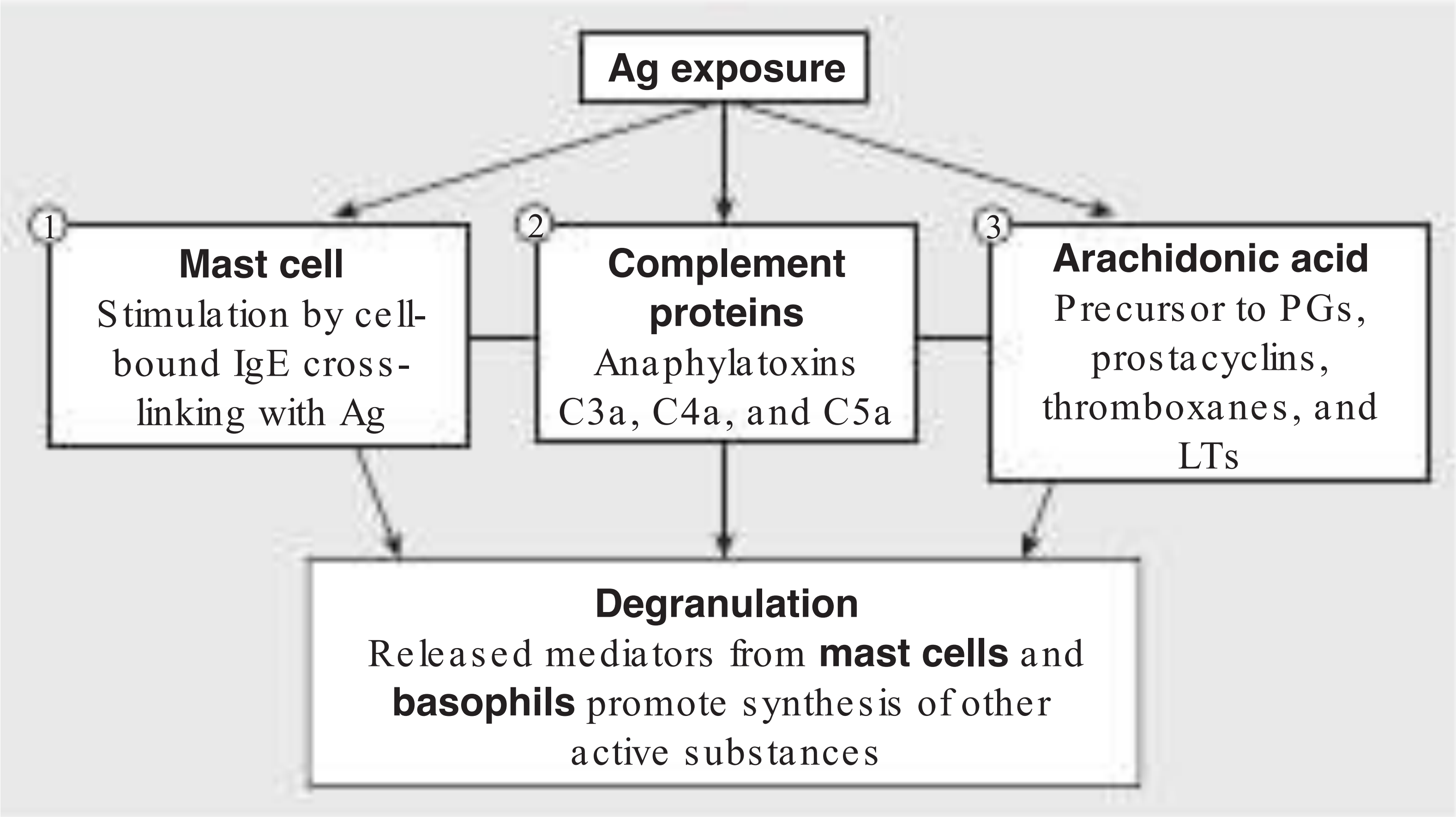

Ag exposure
①
Mast cell
Stimulation by cell-bound IgE cross-linking with Ag
②
Complement proteins
Anaphylatoxins C3a, C4a, and C5a
③
Arachidonic acid
Precursor to PGs, prostacyclins, thromboxanes, and LTs
Degranulation
Released mediators from **mast cells** and **basophils** promote synthesis of other active substances

Figure 3.5. Events that trigger anaphylactic reaction.

ASC box

Anaphylaxis (Figure 3.5)

Mediators involved in anaphylaxis:

- Initial minutes: histamine, tryptase, PGs (PGD_2, $PGF_{2\alpha}$), LTs (LTB_4, LTC_4, LTD_4, LTE_4), and platelet-activating factor
- Hours later: Same cells release cytokines—IL-4, IL-13, and TNF

CAUSAL CONDITIONS (Table 3.16)

TABLE 3.16 • Anaphylaxis casual conditions

Anaphylaxis (IgE-Mediated)	Anaphylactoid Reactions (Non-IgE-Mediated)
Therapeutic agents: antibiotics (PCN most common), vaccines, allergen immunotherapy, local anesthetics **Foods:** peanuts and tree nuts (almonds, Brazil nut, hazelnut), grains, eggs, seafood, milk **Human proteins:** hormones, enzymes, heterologous, serum, blood and blood products **Venoms:** hymenoptera, snake, fire ant **Latex (inhaled or contact)** **Idiopathic**	1. Direct release of mediators from mast cells • Drugs: opiates, neuromuscular blockers • Hypertonic solutions • Exercise 2. Immune complex/complement mediated: • Blood and blood products, gamma globulin, antisera, dialysis membranes 3. Arachidonic acid metabolism modulators • ASA/NSAIDs, COX-2 inhibitor 4. Multiple/unknown mechanisms • RCM, sulfites, idiopathic anaphylaxis

APPROACH

History

- Ingestion within minutes of event: food, candies, drugs (Rx and OTC)
- Recent environmental exposure: insects, bite, sting, plants, fluids, gas
- Recent physical activities such as exercise and sexual activity

Physical Exam

- Most common signs and symptoms: urticaria, angioedema, flushing, pruritus

Investigations

- Serum histamine and serum tryptase, allergy testing (4 wk after anaphylactic event)

Management

- Acute Mx:
  - IV access, O_2, cardiac monitoring, pulse oximetry monitoring.
  - ABC, with particular attention to **airway**. Intubate if stridor, altered mental status, and Resp arrest are present. Treat hypotension with 1 to 2 L IV NS. Vasopressors may be used for refractory hypotension.
  - Epinephrine: give epinephrine 0.3 to 0.5 mg IM q5min (0.3–0.5 mL of 1:1,000 dil).
  - All pts should also receive an antihistamine (loratadine, cetirizine, diphenhydramine) and an IV corticosteroid (methylprednisolone 125 mg). Consider adding an H_2 receptor blocker (ranitidine, famotidine) for additional effect.
  - Mild bronchospasm may also respond to nebulized salbutamol (2.5–5 mg).
- Long-term management:
  - Observe pts in ER for at least 8 h—biphasic response may occur.
  - Pts with severe anaphylaxis should be admitted to hospital.
  - Avoidance/discontinuation of causal agent/drug.
  - Prescribe epinephrine autoinjector (Epipen).
  - Refer pt to an allergy specialist for evaluation.

CLINICAL box

Anaphylaxis is a clinical diagnosis, when it is confirmed by any one of the following three criteria:

1. Acute onset from minutes to a few hours with either skin and mucosal involvement and one or more of the following:
   - Resp compromise: dyspnea, wheeze-bronchospasm, stridor, ↓ expiratory flow, hypoxemia
   - Reduced BP or associated Sx of end-organ dysfunction: hypotonia, collapse, syncope, incontinence
2. Two or more of the following that occur rapidly (minutes to hours) after exposure to a likely allergen for pt:
   - Skin and mucosal tissue: generalized hives, swollen lips-tongue-uvula, itching, flushing
   - Resp compromise: as mentioned earlier
   - *Reduced BP* or associated Sx: as mentioned earlier
   - Persistent *GI Sx*: crampy Abdo pain, vomiting
3. Reduced BP after exposure to known antigen for pt (minutes to hours):
   - Reduced SBP < 90 mm Hg or > 30% ↓ from pt's baseline

CHEST PAIN

MCC OBJECTIVE

Based on Objective #14 (Chest Pain) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Rationale

- Chest pain can have multiple life-threatening or benign causes, but is more commonly benign in the primary care setting. Coronary artery disease usually presents in pts over 40 yr of age (and tends to, on average, present a decade later in women than in men), but can occasionally present in younger pts as well. Physicians must recognize the presentation of CAD and assess its risk factors.

APPLIED SCIENTIFIC CONCEPT

MOD exceeds myocardial O_2 **supply** → stimulation of chemosensitive and mechanoreceptive receptors of unmyelinated cardiac nerve cells → angina

Value of ECG and Cardiac Markers

WHO criteria for MI diagnosis: two out of these three—(a) chest pain—cardiac specific, (b) ECG-ST Δs, T-wave inversions, and (c) ↑ cardiac enzymes

ECG

- **Ischemia**: downsloping or horizontal ST depression
- **Infarction**: ST elevation or T-wave inversion

ASC box

Chest Pain

Causes of ↑ MOD

- ↑ HR
- ↑ Myocardial contractility
- ↑ Myocardial work →↑ MOD
- ↑ Afterload + ↑ preload →↑ wall tension

CAUSAL CONDITIONS (Table 3.17)

TABLE 3.17 • Five deadly causes of chest pain and findings

Disorder	Typical Presentations	Findings in Exam and Workup
Angina	**Typical angina**—all three of the following: • Substernal pressure (may radiate to neck/jaw/shoulders/L arm) • Occurs with exertion/stress • Relieved w/ rest (usually 5–10 min) or nitroglycerin (immediate relief) 2/3 of above = **atypical angina** 0–1/3 of above = **noncardiac pain**	**Physical exam:** usually normal, but may hear an S_4 during chest pain (impaired myocardial relaxation from ischemia) **Workup:** • Careful history • Resting ECG (may show ST) • Depression (ischemia) or Q waves • Prior MI • Cardiac enzymes (should be negative) • Exercise stress test Exercise stress testing, with ECG monitoring, may demonstrate exercise-induced signs of ischemia. ≥ 1 mm of ST depression with exercise (85% of age-predicted maximal [220-age] HR) is a **positive** test
ACS • UA • NSTEMI • STEMI	Unstable angina • New or rapidly worsening pattern of typical angina (see above) that severely limits usual activities or occurs at rest NSTEMI/STEMI • Sudden, severe chest pressure which lasts > 30 min and is associated with diaphoresis, nausea, malaise, sense of impending doom	**Physical exam:** often normal, but may hear an S_4 or a new systolic murmur (in MI—from mitral regurgitation due to papillary muscle dysfunction) **Workup:** • Careful history (unstable angina is diagnosed on history alone), • ECG (STEMI is diagnosed by ECG + supportive history of severe/ongoing chest pain), • Cardiac enzymes (NSTEMI is diagnosed by lack of ST elevation on ECG, a history of chest pain, and elevated cardiac enzymes).
Aortic dissection	• Very severe, sudden onset, sharp/"tearing" pain in the chest and/or back (midscapular)	**Physical exam:** HTN, asymmetric BP/pulses in upper extremities (> 20 mm Hg difference), HF/aortic insufficiency (diastolic murmur)/hypotension (from tamponade or AI) in ascending aortic dissection **Imaging:** • **CXR**: look for widened mediastinum, pleural effusion (may miss aortic dissection, so further testing required if high suspicion) • **Contrast CT:** fast, noninvasive, high sensitivity (85% for proximal; 90% for distal). Readily identifies true lumen (contrast) from false lumen (no contrast) • **TEE:** can assess pericardium, AI. No contrast required (safe in renal failure). Sensitivity > 95% for proximal and 80% for distal • **MRI:** (gold standard) sensitive and specific (> 98%), but not readily available, time consuming

(Continued)

TAbl E 3.17 • Continued

Disorder	Typical Presentations	Findings in Exam and Workup
Tension pneumothorax	• Sudden, pleuritic pain (sharp pain that is worse with deep inspiration), along with shortness of breath • Usually unilateral	**Physical exam:** unilateral reduced breath sounds with hyperresonance on percussion. **Imaging:** • **CXR**: may see mediastinal shift, distinct pleural lining. Expiratory views can help confirm if uncertain
Pulmonary embolism	• Sudden, pleuritic pain, along with severe shortness of breath. May be associated with syncope • Tachypnea, tachycardia	**Physical exam:** tachycardia and tachypnea common. May hear a loud S_2 (pulmonic component), feel a parasternal heave (right ventricular pressure overload), or a new RUSB systolic murmur (pulmonary insufficiency from pulmonary HTN = Graham Steel murmur) **Workup:** • **D-Dimer:** positive in 99% of cases, but high false positive rate (if low index of suspicion, negative D-Dimer is sufficient to rule out PE) • **ECG:** sinus tachycardia (most common). May see T-wave inversions in V_1–V_3 from right ventricular strain or "S_1, Q_3, □3" pattern • **AbG**: hypoxemia, with A-a gradient • **Imaging**: V/Q scan, contrast CT chest, or angiogram is confirmatory

- **CV** (25% of causes, 50% in elderly pts)
  - **Coronary artery disease:**
    - Angina pectoris, ACS, coronary vasospasm, cardiac syndrome X (rare—microvascular dysfunction leading to angina, with normal epicardial coronary arteries)
  - **Aortic pathology:**
    - Aortic dissection (tear in aortic intima, with blood accumulation in a false lumen), ruptured aortic aneurysm
  - **Pericarditis:**
    - **Infectious** (viral, bacterial, TB), **post-MI** (acute = hemorrhage into pericardium, subacute = autoimmune reaction to myocardial/pericardial proteins, "Dressler syndrome"), **uremic**, **connective tissue disease**
- **GI (20%)**
  - Esophageal spasm, esophagitis, peptic ulcer disease, Mallory-Weiss tear (from severe retching/vomiting), biliary disease, and pancreatitis
- **Neuropsychiatric (10%)**
  - Cardiac neurosis/anxiety, depression, somatoform
- **Pulmonary/mediastinal (5%)**
  - Pulmonary embolus, pneumothorax, pleurisy (often viral/bacterial pneumonia associated), mediastinal/pulmonary malignancy, tracheitis
- **Musculoskeletal and cutaneous**
  - Chest wall pain (typically pain is reproducible on palpation), costochondritis

APPROACH (Figure 3.6)

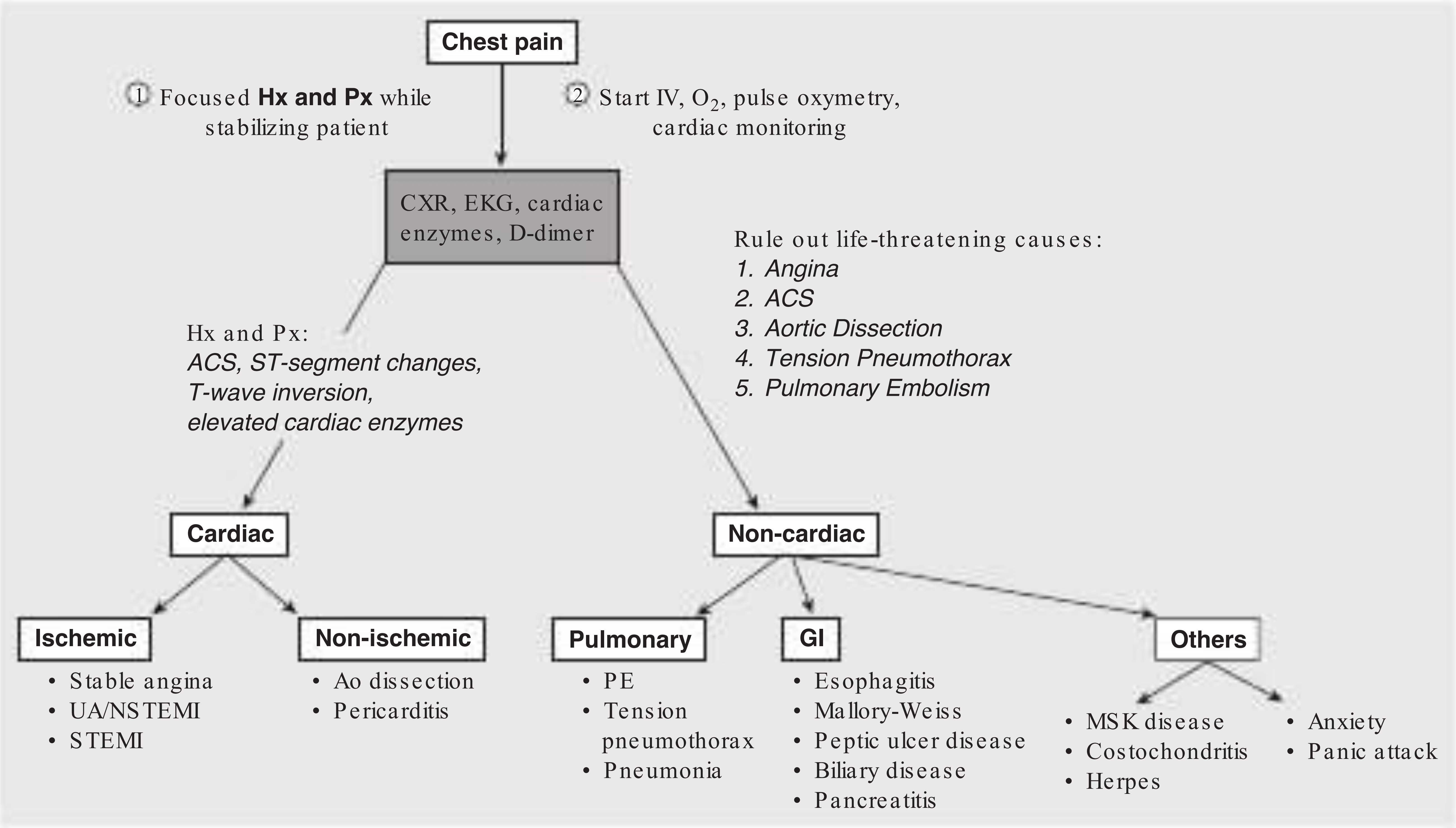


Figure 3.6. Approach to chest pain.

History ("OPQRST")

- Onset—sudden versus gradual, when did pain start?
- Position—substernal versus left/right chest (unilateral) versus back
- Quality—dull, sharp, tearing
- Radiation—neck, shoulders, left arm, back (midscapular)
- Associated Signs—diaphoresis, nausea/vomiting, syncope, shortness of breath
- Timing—with exertion/stress versus at rest versus deep breathing (pleuritic) versus lying flat (pain is pleuritic and improved with sitting forward in pericarditis)

Physical Exam

- Vital signs
- CV exam
- Pulmonary exam

Management

- Initial approach should be aimed at identifying/ruling out life-threatening causes

Stable Angina

- If pain is severe, progressive, or prolonged, consider ER evaluation to urgently R/O ACS
- Acute pain relief:
  - Nitroglycerin (0.4 mg SL q5min × 3)
- Medical therapy:
  - ASA 81 mg daily + high-dose statin (Lipitor 40–80 mg, Crestor 20–40 mg), to reduce risk of ACS
  - Antianginal medications: b-blockers (1st line), CCBs, long-acting nitrates to provide symptomatic relief
- Risk stratification:
  - Stress testing can help identify high-risk angina
  - Pts with high-risk angina should undergo coronary angiography to rule out prognosis-altering CAD (3VD or LM CAD)

- PCI/CABG:
  - PCI is more effective than medical therapy at symptom relief, but does *not* prevent MI or death in **stable angina**
  - CABG should be offered to pts with prognosis-altering CAD (3VD or LM CAD) or to those who have medication-refractory angina that is not amenable to PCI

ASC box

ACS

APPLIED SCIENTIFIC CONCEPTS

Acute Coronary Syndromes represent a spectrum of conditions that share a common pathophysiology (intra-coronary thrombosis). Clinical differentiation between the different diagnoses of UA, NSTEMI and STEMI is made using cardiac troponins and 12-lead ECG.

UA	NSTEMI	STEMI
• Sub-total occlusion by intra-coronary thrombus • Myocardial ischemia, but no myocardial infarction	• Sub-total occlusion by intra-coronary thrombus • Myocardial infarction (typically non-transmural)	• Complete occlusion by intra-coronary thrombus • Large, transmural infarction (if flow is not immediately restored)

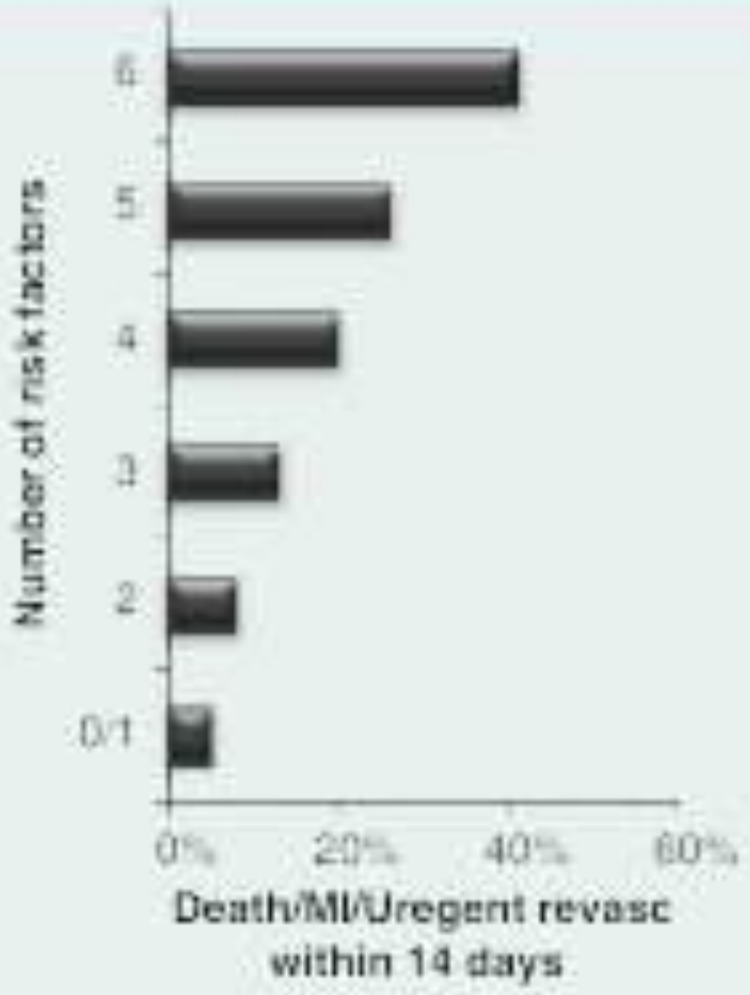
A spectrum of diagnoses (UA, NSTEMI, STEMI) that share a common pathophysiology—*atherosclerotic plaque rupture* and *coronary*

ACS (or Suspected ACS)

- Initial stabilization/monitoring: O_2, IV access, cardiac monitoring, **ASA 160 mg PO**, 12-lead ECG
- Acute pain relief:
  - SL nitroglycerin (0.4 mg SL q5min × 3), IV nitroglycerin (10–40 mg/min IV if SL nitroglycerin only partially effective), morphine (2–4 mg IV if SL nitroglycerin ineffective)
- Workup (see Table 3.16):
  - 12-lead ECG (immediately—to R/O STEMI)
  - Serial cardiac enzymes (immediate, then repeated in 6 h—to R/O NSTEMI)
  - Careful history (looking for severe/progressive/prolonged CP—to R/O UA)
- UA/NSTEMI Mx:
  - Medical therapy (see Rx below) and risk factor identification/modification
  - Ongoing cardiac monitoring in CCU for arrhythmias, recurrent CP
  - Estimate prognosis (see Table 3.18—TIMI risk score) to determine whether conservative or invasive approach is best

TABLE 3.18 • TIMI risk score for UA/NSTEMI

History/Investigations	Points
Age > 65 yr	1
≥ CAD risk factors	1
Known CAD	1
ASA use in past 7 d	1
Recent (< 24 h) severe angina	1
Troponin +	1
ST deviation ≥ 0.5 mm	1
Risk score 5	**Total point (0–7)**



  - **Invasive approach** (for most pts): coronary angiography/echo
  - **Conservative approach**: stress testing/echo, with coronary angiography for pts with high-risk stress test results or EF < 40%
- UA/NSTEMI Rx:
  - ASA (160 mg load, then 81 mg daily)—lifelong
  - Additional antiplatelet Rx (clopidogrel, prasugrel, ticagrelor)—× 1 yr for most
  - Anticoagulation (LMWH preferred over heparin unless GFR < 30)—× 48 to 72 h
  - High-dose statin (Lipitor 40–80 mg, Crestor 20–40 mg)—lifelong
  - b-Blocker (metoprolol, bisoprolol)—× 1 yr or longer, depending on EF
  - ACEI (ramipril, lisinopril, Coversyl)—× 1 yr or longer, depending on EF
  - Revascularization with PCI (favored for single- or two-vessel CAD) or CABG (favored for 3VD, LM CAD, EF < 40%, diabetics) has been shown to reduce the risk of death/MI in pts at intermediate (TIMI 3–4) or high risk (TIMI 5–7)
- STEMI Mx:
  - Urgent reperfusion therapy with primary PCI or thrombolysis is key
  - Primary PCI has higher success (90%–95% vs. 60%–70%) and less major bleeding complications (1% risk of ICH with thrombolysis)
  - All pts should also receive dual antiplatelet Rx (ASA + clopidogrel/prasugrel/ticagrelor) and an anticoagulant (heparin or LMWH)
  - Ultimately, choice of reperfusion strategy depends on:
    - Risk from MI (anterior vs. inferior, CHF)—high risk favors PCI
    - Risk of bleeding (prior ICH, recent stroke, brain tumor, bleeding, diathesis, uncontrolled HTN)—high risk favors PCI
    - Timely access to cath lab—delay > 60 to 90 min favors thrombolysis
  - After reperfusion has been achieved:
    - Ongoing cardiac monitoring in CCU for arrhythmias, recurrent CP
    - If thrombolysis given and successful, coronary angiography in the next 6 to 24 h is advised. If unsuccessful, emergency "rescue" PCI ASAP
    - Optimization of medical therapy (similar to UA/NSTEMI Rx above) and risk factor identification/modification (Figure 3.7)

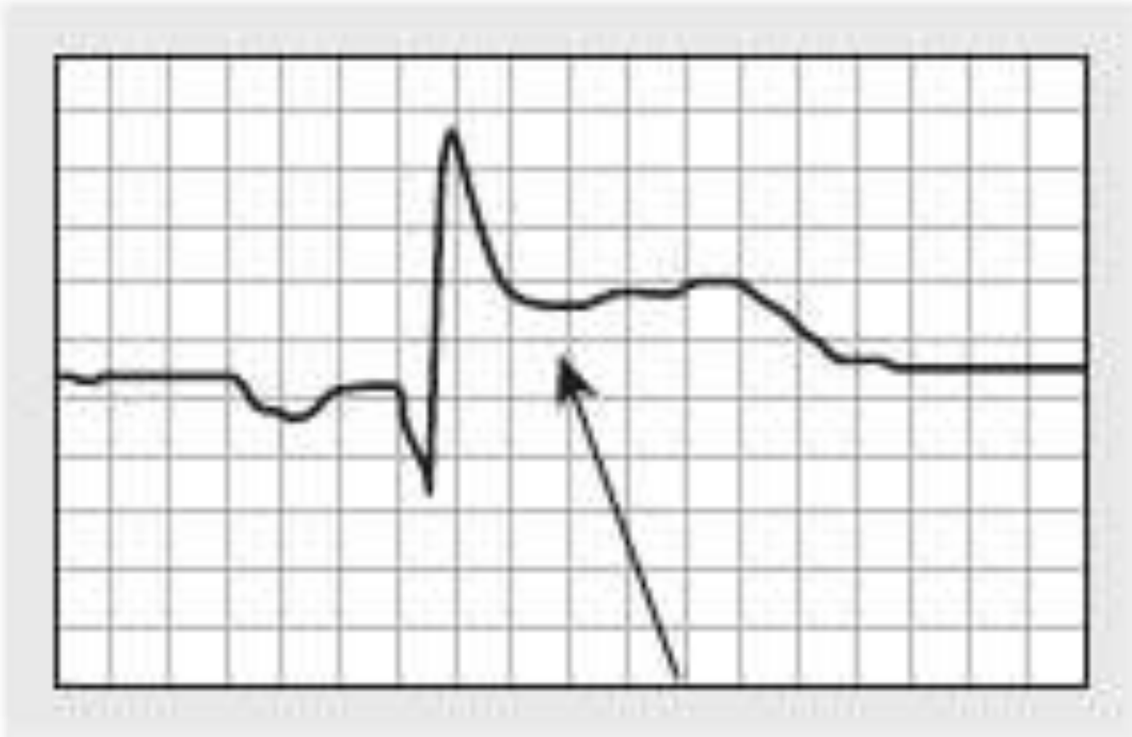


Figure 3.7. Acute ST elevation.

Aortic Dissection (Figure 3.8)

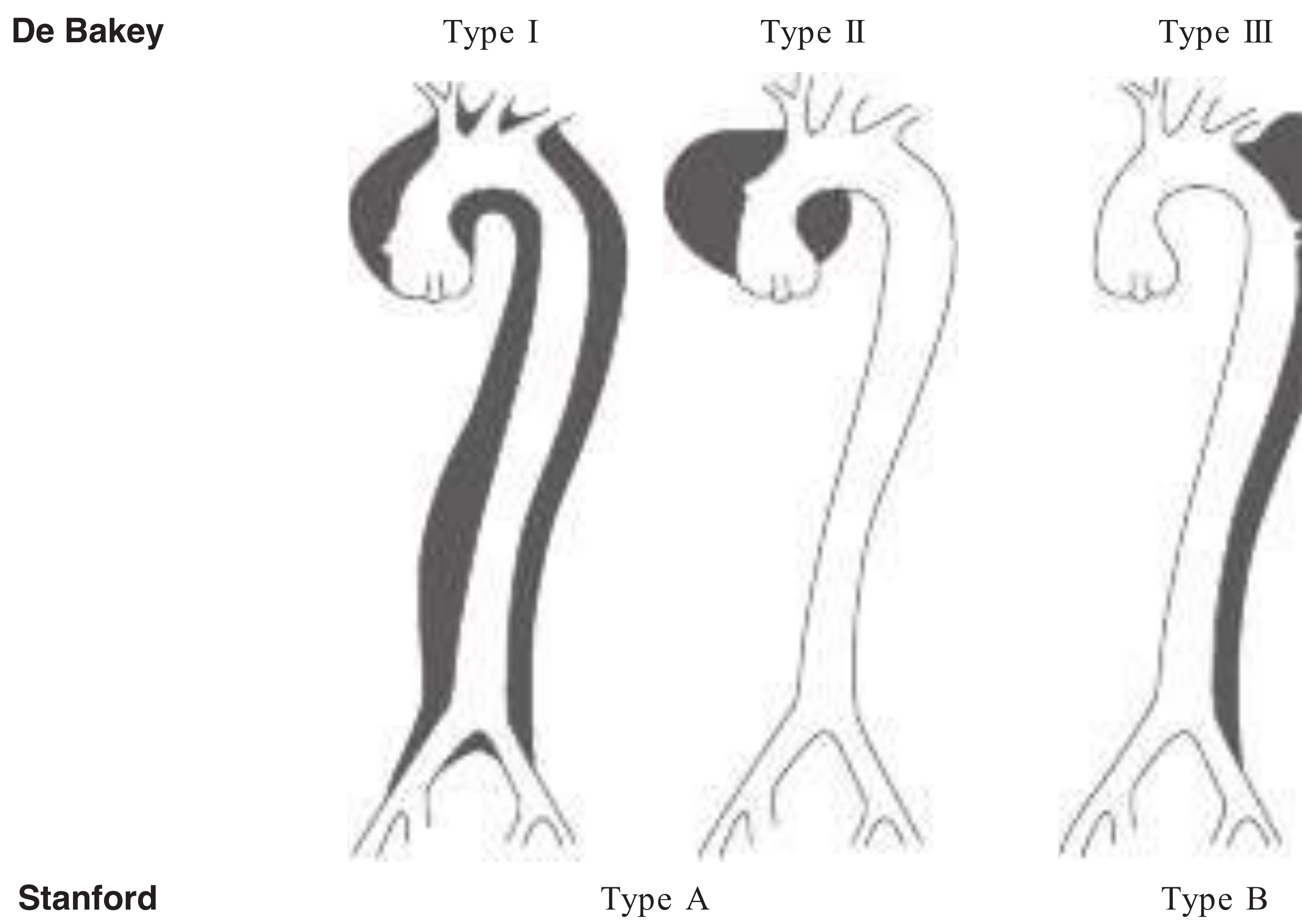


Figure 3.8. Aortic dissection. Proximal dissection (left, center) (Stanford A, DeBakey I/II)—surgical root replacement. Distal dissection (right) (Stanford B, DeBakey III)—surgery is generally avoided (unless critical organ ischemia).

(Reprinted with permission from Herzog E. *The Cardiac Care Unit Survival Guide*. Philadelphia, PA: Lippincott Williams & Wilkins; 2012.)

- All pts should receive appropriate medical therapy, including admission to ICU for continuous BP monitoring and appropriate IV therapy to lower BP (see Hypertensive Crises section for medical management)
- HR should be aggressively controlled with b-blockers in order to reduce shear stress on intimal tear (*shear stress* α $\Delta P/\Delta T$)
- Pain control with morphine as needed
- Decisions about surgical management depend on type of dissection

Pericarditis

- Rule out pericardial tamponade (pulsus paradoxus, tachycardia, hypotension, muffled heart sounds, "bottle shaped" heart on CXR)
- Rule out secondary causes (uremia, connective tissue disease, cancer, TB)
- Echocardiogram to assess size of effusion
- If viral/idiopathic: NSAIDs, colchicine, corticosteroids (if refractory)
- If large effusion/tamponade: pericardiocentesis
- If recurrent large effusion/tamponade: pericardial window

CARDIAC ARREST

MCC OBJECTIVE

Based on Objective #13 (Cardiac Arrest) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Rationale

- Approximately 45,000 cardiac arrests occur each year in Canada (Heart and Stroke Foundation)
- The most common rhythm in sudden cardiac death is VF
- For each minute delay in defibrillation, survival decreases by 7% to 10%
- 85% of cardiac arrests occur at home (65%) or in public places (20%)
- Less than 5% of pts with cardiac arrest outside of hospital survive

CAUSAL CONDITIONS (Table 3.19)

TABLE 3.19 • Cardiac arrest: causal conditions

- Cardiac causes
- Abnormalities of coronary arteries (85% of cases)
  - CAD (MI, with angina/silent)
  - Coronary artery spasm or embolism
  - Tachyarrhythmias (VF/VT and AF/AFL)
- Abnormalities of cardiac conduction
  - Congenital
  - Acquired
    - Metabolic ($\downarrow K^+$, $\downarrow Mg^{2+}$, $\downarrow Ca^{2+}$, anorexia/starvation)
    - Bradyarrhythmias
      - Sinus node dysfunction
      - AV block (second and third degree)
      - Antiarrhythmic drugs
    - Other
      - Antimicrobial drugs
      - Psychotropic drugs
      - Vasodilator drugs
      - Serotonin antagonists
      - Street drugs
- Abnormalities of myocardium
  - Hereditary (hypertrophic/dilated cardiomyopathy and RV dysplastic syndrome)
  - Acquired (associated with coronary atherosclerosis ischemic injury, HTN, DM)
    - LVH
    - LV systolic/diastolic dysfunction
    - Valvular disease and atrial myxoma
    - Myocarditis and myocardial/aortic rupture

- Noncardiac causes
- Acute CT
- PE
- Airway obstruction and TP
- 1° edema
- Chest wall trauma

Mnemonic:
CT, TP, PE, ED,
Trauma

APPROACH

Prearrest

- First step is to determine whether the pt has an advance directive—do not begin CPR if pt has expressed a clear wish to not be resuscitated (i.e., DNR order on file/chart)
- If unsure or no record on file, then begin resuscitation without delay
- Out of hospital:
  - Check for **responsiveness**/confirm lack of **pulse**, call for **help** (emergency medical system/911), provide **basic life support** (hands-only CPR, AED ASAP) until paramedics/ACLS equipment arrive
- In hospital setting:
  - Check for **responsiveness**/confirm lack of **pulse**, call for **help** (code blue), provide **basic life support** (CPR + bag-mask ventilation/100% O_2) until crash cart arrives

- Check heart rhythm, ensure IV access, and manage according to latest **ACLS guidelines:**
  - **Asystole/PEA**—CPR and epinephrine 1 mg IV q3–5min. Consider potentially reversible causes—5Hs and 5Ts
  - **VF/pulseless VT**—defibrillate at 200 J (biphasic) with CPR between shocks, and give epinephrine 1 mg IV q3–5min and amiodarone 300 mg IV if VF/pulseless VT persists/returns after three shocks. Consider hypomagnesemia and hypokalemia and treat if present
  - **Stable, severe tachycardia (VT or SVT)**—check for symptoms of hypoperfusion (decreased LOC, severe hypotension, severe chest pain, etc.) and cardiovert if present. If stable, do 12-lead ECG first, then consider adenosine if regular HR (will terminate certain narrow and wide complex rhythms). If irregular HR and atrial fibrillation suspected, then give b-blockers, CCBs, or digoxin for atrial fibrillation. Consider cardiology consultation
  - **Severe bradycardia**—check for symptoms of hypoperfusion (decreased LOC, severe hypotension, severe chest pain, etc.) and try atropine 1 mg if present. If no response, then either transcutaneous pacing or IV dopamine/epinephrine (to stimulate an escape rhythm) is an equally reasonable option. Consider hyperkalemia (i.e., end-stage renal failure) and treat if present
- Consider delaying intubation for at least 5 to 10 min if adequate bag-mask ventilation can be administered, as an accidental esophageal intubation (common in a code situation) is often fatal
- If a normal rhythm returns, check for a pulse and vital signs and provide supportive care

CARDIAC ARREST

!

The Hx and Ts for reversible causes of cardiac arrest:

Hypoxia, Hypo/hyperkalemia, Hypo/hyperglycemia, Hypovolemia, Hypothermia, Hydrogen ions (acidosis)

Tension pneumothorax, Tamponade, Toxins, Thromboembolism (PE)/Thrombosis (MI)

Postarrest Management

History

- Determine symptoms/signs that occurred before the arrest from witnesses
- Collect detailed medical history (including CAD, CHF, CAD RF), medication history, family history of sudden cardiac death
- Confirm whether the pt has an advance directive

Physical Exam

- Vital signs (BP, HR, RR, oxygen sat, temperature, Chemstrip)
- Screening neurological exam (GCS, cranial nerves, gross motor/sensory exam)
- Cardiac exam (JVP, heart sounds, murmurs)
- Resp exam (bilateral air entry to confirm ETT placement, percussion for pleural effusion/pneumothorax, breath sounds for crackles/wheeze)
- Peripheral exam (signs of DVT, signs of HF)

Investigations

- Labs (ABG, CBC, full lytes, urea, creatine, liver enzymes, lipase, PT, PTT, troponin, TSH, tox screen), 12-lead ECG, CXR

Management

- Advanced care following initial resuscitation:
  - Correct immediately life-threatening conditions (pulmonary embolism, tension pneumothorax, cardiac tamponade, airway obstruction, blood loss, hyperkalemia, drug overdose/toxic ingestion)
  - Consider **mild therapeutic hypothermia**, particularly if GCS ≤ 13 and not rapidly improving, downtime 10 min to 1 h, VT or VF initial rhythm, or no contraindication to cooling (ongoing bleeding, severe hypotension/hemodynamic instability, prognosis-altering comorbidities such as advanced cancer); this has been shown to dramatically improve long-term neurologic outcomes postcardiac arrest, but is resource intensive (intubation, sedation, ± paralysis, careful hemodynamic support × 24 h)
  - If cardiac arrest was not due to a reversible cause (i.e., ACS), consider implantable cardioverter-defibrillator implantation once stable

C_2 L E O

- Beneficence: special ethical responsibility of the physician to act in the best interest of the pt.
- Autonomy: The capacity to make informed, uncoerced decision. In the medical context, it is the obligation to respect pts as individuals and honor pts' preferences in Rx.
- Informed consent: For every Rx recommended, pt must understand risk, benefits, and alternatives, including Ø intervention.

Advanced Directives

- **Oral AD**: Incapacitated pt's oral directive whether to give or withdraw Rx. It is more valid than a written directive if pt was informed, directive is specific, and the decision of the pt is repeated over time.

- **Written AD**: can be in the form of a living will or appointing an enduring power of attorney.
- **Living will**: Pt directs care team of wishes/goals of care in the event that the pt is unwilling to make decisions. For example, pt may indicate desire to withdraw/ withhold life-sustaining Rx when pt develops terminal disease or enters a persistent vegetative state.
- **Enduring power of attorney**: Pt designates someone else to make medical decisions in the event pt loses the capacity to do so.

C2LEO

Informed Consent

Legally, informed consent requires:

1. Discussion of pertinent information
2. Pt's agreement of care
3. Freedom from coercion

Exceptions to informed consent:

1. Pt is not competent in making decision (must find alternative, e.g., power of attorney)
2. Implied consent, in an emergency situation
3. Therapeutic privilege—when disclosure would harm pt or undermine informed decision-making capacity
4. Pt waives the right of informed consent

SYNCOPE

MCC OBJECTIVE

Based on Objective #106 (Syncope and Pre-Syncope) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Definition

- Transient loss of consciousness, due to global cerebral hypoperfusion

Rationale

- 50% of all Canadians will suffer at least one fainting episode (neurocardiogenic syncope) over the course of their lifetime. On the other hand, some causes of syncope have important underlying causes that are associated with a poor prognosis (predominantly cardiac causes)

APPLIED SCIENTIFIC CONCEPT

Relationship between BP, CO, and SVR

$$\begin{aligned} \text{SVR} &= \text{MAP} - \text{CVP} \\ \text{CO} &= \mathbf{X}\ \text{mm Hg/L/min} \\ \mathbf{MAP} &= \text{dBP} + 1/3\ \text{pulse pressure} \end{aligned}$$

Relationship between CO, SV, and HR

$$\text{CO} = \text{HR} \times \text{SV}$$

Relationship between SV, Contractility, Preload, and Afterload

SV is determined by three main factors: preload, afterload, and contractility.

Preload: ventricular volume at the end of diastole; ↑ preload leads to ↑ SV

Starling law of the heart → energy of contraction of the muscle is proportional to the initial length of the muscle fiber.

Afterload is the resistance to ventricular ejection. This is caused by the resistance to flow in the systemic circulation and is the **SVR**.

Vascular capacitance refers to degree of active constriction of vessels (mainly veins), which affects return of blood to the heart.

Therefore, ↑ in intravascular volume → ↑ in vascular capacitance → ↑ in preload

CAUSAL CONDITIONS

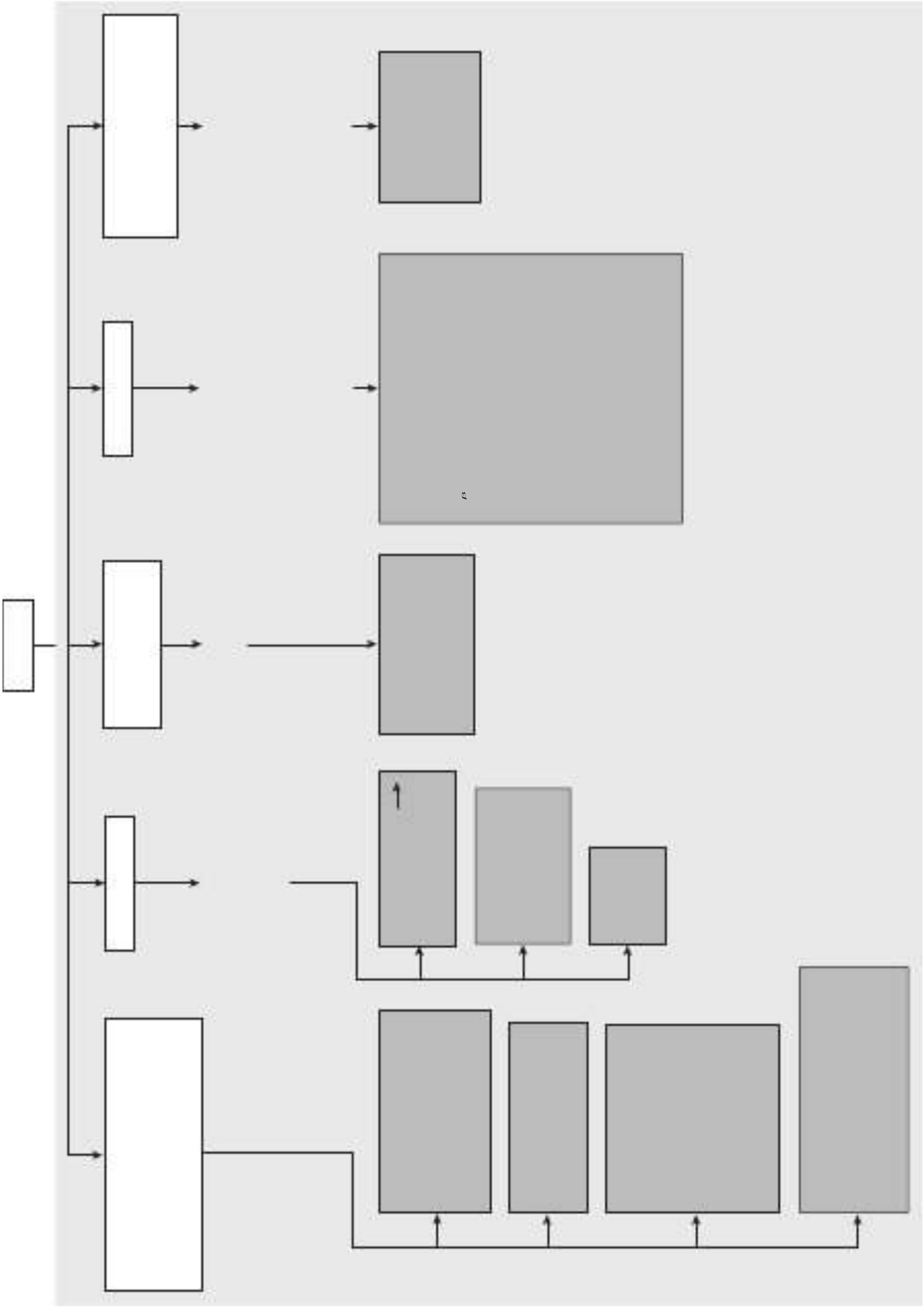
- **Neurocardiogenic** (most common and usually benign):
  - Vasovagal syncope
  - Situational syncope (postmicturition, postdefecation, postcough)
  - Carotid sinus hypersensitivity (asystole and syncope with carotid sinus massage)
  - Orthostatic (20/10 mm Hg drop in BP + symptoms upon standing)
- **Cardiac:**
  - Bradyarrhythmias (heart block, sinus arrest, tachy-brady syndrome)
  - Tachyarrhythmias (VT, rarely SVT)
  - Obstructive (AS, HOCM, MS, atrial myxoma, massive pulmonary embolism)
- **Psychogenic:** hyperventilation-related, panic disorder, malingering

ASC box

Syncope

Autoregulation of Cerebral Blood Flow

- ↑ Production of vasodilators → ↓ cerebral arteriolar resistance → reestablish cerebral blood flow
- Constriction of systemic vasculature of skin, splanchnic bed, muscles → diverting blood to brain
- ↑ Sympathetic output → ↑ contractility and ↑ peripheral resistance → ↑ arterial pressure



- **Cerebrovascular** (rare, as must cause global/bihemispheric hypoperfusion to cause syncope)**:**
  - Vertebrobasilar insufficiency, subclavian steal syndrome, severe carotid artery disease, bilateral TIA
- **Pseudosyncope** (mimics syncope by causing LOC/weakness, but not cerebral hypoperfusion)**:**
  - Seizure
  - Hypoglycemia
  - Hypoxia
  - Drug intoxication/overdose, EtOH abuse

CLINICAL box

Causes of Syncope

Seizure
Vasovagal
Neurocardiogenic
Cardiac
Occasional (situational)
Psychogenic
Everything else

APPROACH (Figure 3.9)

History

- The most crucial component of workup
- Clarify symptoms/signs/events **before** (no prodrome/warning vs. exertional vs. upon standing vs. nausea, light-headedness, diaphoresis, pallor vs. chest pain/palpitations), **during** (seizure/loss of bowel or bladder continence, tongue biting, injury during fall), and **after** (rapid recovery [minutes] vs. long postictal phase)
- Obtain detailed medial history, including medication history:
  - If preceded by pain/strong emotion, nausea/light-headedness/diaphoresis, consider vasovagal
  - If preceded by urination, defecation, swallowing, coughing, consider situational
  - If preceded by neck manipulation, arm exertion, consider cerebrovascular
  - If preceded by exertion, chest pain/SOB/arrhythmia or no prodrome at all, Hx of CAD/CHF, family Hx of sudden death/drowning, consider cardiac
  - If preceded by standing up, history of postural light-headedness , on α-blockers/diuretics/nitrates, consider orthostatic
  - If history of psychiatric disorder, consider psychogenic
  - If diabetic/on insulin, illicit drug use, EtOH abuse, consider pseudosyncope

Physical Exam

- Vitals (postural BP, HR, O_2 sat [if low consider PE], RR)
- Neurologic (GCS, cranial exam, gross motor/sensory exam)
- Cardiac (JVP, heart sounds [extra sounds], heaves, murmurs, carotid sinus massage)
- MSK (signs of injuries sustained during syncope)

Investigations

- ECG
- Labs (CBC, lytes, urea, glucose/Chemstrip, creatinine)
- Further testing as guided by history (CT head/EEG, tilt table testing, CT chest for pulmonary embolism, CXR, echocardiogram, EP studies, Holter monitor, implantable loop recorder)

Management

- Ensure ABCs, obtain IV access, place pt on cardiac monitor
- Obtain careful history, exam, initial investigations
- If cause unclear, determine if high risk (possible cardiac) versus low risk and admit for ECG observation ± further workup (echo, etc.) if high risk (Table 3.20)

TABLE 3.20 • High-risk features of syncope from a cardiac etiology

History			Physical Exam	ECG	
Prior MI	No prodrome	Exertional	Murmur	Q wave	AV block (any)
Low EF	Severe injury	Family history of sudden death	Hypoxia	Bundle branch block	Bradycardia (< 50 bpm)
Chest pain or palpitations preceding			Signs of HF	Prolonged QT	Unexplained tachycardia

ABNORMAL PULSE

MCC OBJECTIVE

Based on Objective #87 Abnormal pulse is no longer an Objective of Objectives for the Qualifying Examination, 3rd edition.

ASC box

AbN Pulse (Figure 3.10)

Laminar flow: Laminar flow aka streamline flow occurs when a fluid flows in parallel layers, with no disruption between the layers. There is no current perpendicular to the direction of flow. In fluid dynamics, laminar flow has high momentum diffusion, low momentum convection, and constant pressure and velocity.

Turbulent flow: Flow regime characterized by chaotic, stochastic property Δs. This includes low momentum diffusion, high momentum convection, and rapid variation of pressure and velocity in space and time.

Overview

Rationale

- The characteristics of arterial pulse should be assessed as an important part of the cardiac exam. The central pulses (assessed at carotid and/or femoral arteries) can be palpated for amplitude, contour, and upstroke. Peripheral pulses (radial, brachial, popliteal, posterior tibialis, dorsalis pedis) should be examined bilaterally for pulse deficit, which may suggest dissection, aortic coarctation, or peripheral vascular disease.

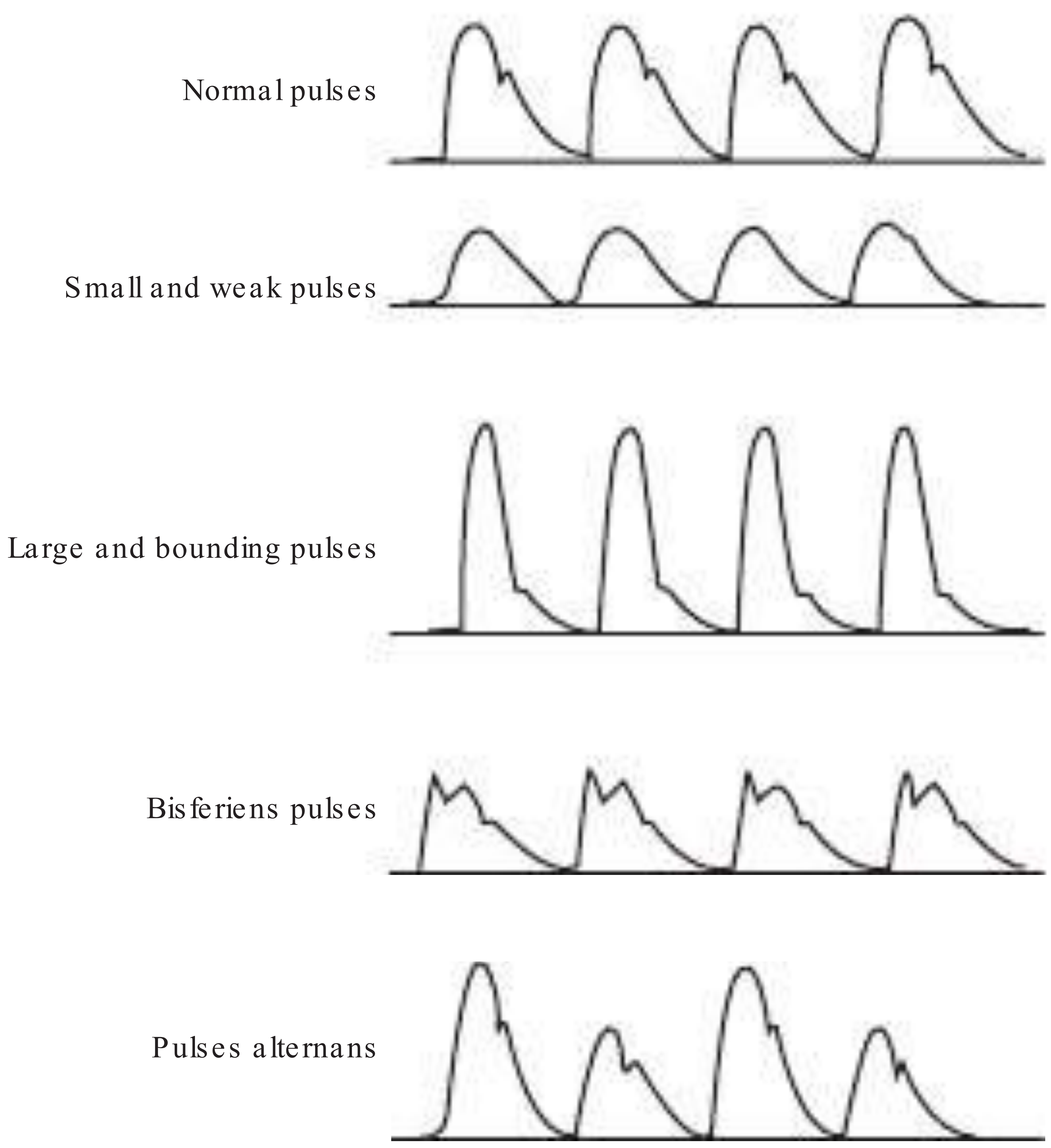


Figure 3.10. AbN volume pulses.

Applied Scientific Concept

At very low speed, blood flow is laminar. When there is ↑ in velocity from either narrowing of blood vessels (↓l) or ↑ flow rate, at some point the transition is made to turbulent flow.

$$\text{Flow} = \frac{\Delta p \times p \times r^4}{8 \times h \times l}$$

(Δp = pressure difference between two ends; r = radius of the tube; η = viscosity of fluid; l = length of tube)

Causal Conditions (Table 3.21)

Table 3.21 • Causal conditions of AbN pulses

Unequal or delayed pulses	**Obstructive arterial disease** (i.e., atherosclerosis) **Aortic disease** Dissection (> 20 mm Hg Δ between arms), aneurysm, coarctation (brachiofemoral delay), supra/valvular AS (pulses tardus et parvus; delayed and weak) **Takayasu arteritis** (systemic Sx: fever, weight loss, myalgia, erythema nodosum, intermittent HTN): asymmetric BP (> 20–30 Δ) and pulses, aortic and subclavian bruits, absent pulses (rare), retinal and vitreous hemorrhage, cotton-wool spots

(Continued)

TABLE 3.21 • Continued

Rhythm irregular/ too fast/too slow	**Tachycardia** (> 100/min)
	Sinus
	Fever, sepsis, hyperthyroid
	Volume depletion: hypotension, shock, cardiac failure
	Anemia, hypoxemia, drugs
	Bradycardia (< 45/min)
	Normal heart: during sleep, athletes, some elderly
	Intrinsic to heart: infiltrative disease, collagen disease, open heart surgery
	Extrinsic: vagal stimulation, drugs, hypothyroid, hypothermia, ABN K levels
	Arrhythmia (see **Palpitation**)

- Types of pulses:
  - Pulsus alternans:
    - Alternating weak and strong pulses with fixed cycle length
    - Present in: systolic dysfunction/low EF
  - Pulsus bisferiens:
    - Biphasic pulse
    - Present in: AS plus AI, severe AI, and HOCM
  - Dicrotic pulse:
    - Double peak, with weaker second beat
    - Present in: low arterial pressure/PVR, very low EF, post AVR
  - Anacrotic pulse/pulsus parvus et tardus:
    - Slow rising, typically with an ascending notch
    - Present in aortic stenosis
  - Corrigan pulse (water hammer/collapsing):
    - Rapid pulse then sudden collapse
    - Present in aortic insufficiency
  - Pulsus paradoxus:
    - Exaggerated inspiratory decrease in arterial pulse amplitude
    - Present in cardiac tamponade, asthma, hypovolemic shock

APPROACH

History

- Cardiac symptoms (angina, shortness of breath, syncope), claudication
- Previous Hx of CV disease: congenital heart disease (coarctation of the aorta, bicuspid aortic valve with aortic stenosis), prior MI, previous heart surgery, valvular disease, PVD
- Toxic ingestion: med overdose, smoking (PVD), substance abuse
- Exposure: to extremes of temperature

Physical Exam (Table 3.22)

TABLE 3.22 • Grading of peripheral vascular disease by ankle–brachial index

Ankle–Brachial Index	Interpretation
> 1.30	**Calcified vessels** resulting in exaggerated pulsatile waveform amplification in distal lower extremities
1.0–1.3	**Normal ABI** (BP is normally higher in the lower extremities than in the upper extremities)
0.5–0.9	**Mild-to-moderate peripheral vascular disease**, which may be associated with claudication
0.3–0.5	**Severe peripheral vascular disease**, which may be associated with severe claudication or resting pain
< 0.3	**Limb-threatening peripheral vascular disease**, which may be associated with gangrenous extremities

- Palpate radial pulse bilaterally for radio–radio delay
- Measure BP in both arms and legs using appropriately sized cuffs if CoA is suspected
- Examine popliteal pulses if lower leg arterial disease is suspected
- Auscultate the heart for any murmur, extra heart sounds (S_3, S_4, clicks)

Management (Figure 3.11)

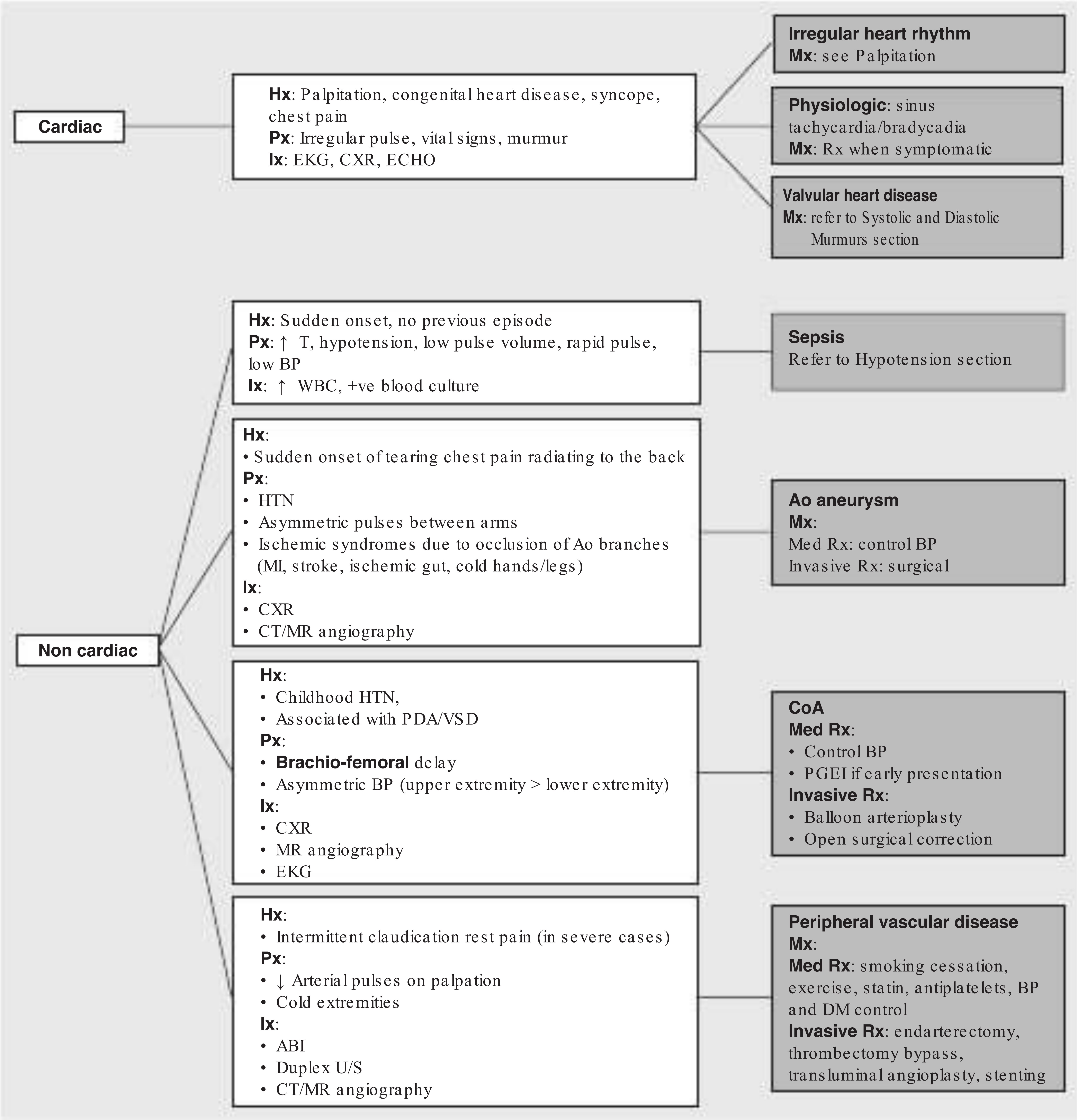

Cardiac
Hx: Palpitation, congenital heart disease, syncope, chest pain
Px: Irregular pulse, vital signs, murmur
Ix: EKG, CXR, ECHO
Irregular heart rhythm
Mx: see Palpitation
Physiologic: sinus tachycardia/bradycadia
Mx: Rx when symptomatic
Valvular heart disease
Mx: refer to Systolic and Diastolic Murmurs section
Non cardiac
Hx: Sudden onset, no previous episode
Px: ↑ T, hypotension, low pulse volume, rapid pulse, low BP
Ix: ↑ WBC, +ve blood culture
Sepsis
Refer to Hypotension section
Hx:
• Sudden onset of tearing chest pain radiating to the back
Px:
• HTN
• Asymmetric pulses between arms
• Ischemic syndromes due to occlusion of Ao branches (MI, stroke, ischemic gut, cold hands/legs)
Ix:
• CXR
• CT/MR angiography
Ao aneurysm
Mx:
Med Rx: control BP
Invasive Rx: surgical
Hx:
• Childhood HTN,
• Associated with PDA/VSD
Px:
• Brachio-femoral delay
• Asymmetric BP (upper extremity > lower extremity)
Ix:
• CXR
• MR angiography
• EKG
CoA
Med Rx:
• Control BP
• PGEI if early presentation
Invasive Rx:
• Balloon arterioplasty
• Open surgical correction
Hx:
• Intermittent claudication rest pain (in severe cases)
Px:
• ↓ Arterial pulses on palpation
• Cold extremities
Ix:
• ABI
• Duplex U/S
• CT/MR angiography
Peripheral vascular disease
Mx:
Med Rx: smoking cessation, exercise, statin, antiplatelets, BP and DM control
Invasive Rx: endarterectomy, thrombectomy bypass, transluminal angioplasty, stenting

Figure 3.11. Approach to AbN pulses.

DYSLIPIDEMIA

MCC OBJECTIVE

Based on Objective #51 (Abnormal, Serum Lipids) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Definition

- One or more specific alterations in serum lipids (elevated fasting TC, LDL, TG, apoB, or low HDL), which have been shown to be associated with an increased risk of cardiovascular disease in multiple epidemiologic studies. These alterations are often due to lifestyle factors or medical comorbidities (secondary), but can also be hereditary or found in isolation (primary).

APPLIED SCIENTIFIC CONCEPT

- Hypercholesterolemia, particularly **elevated LDL**, and **low HDL** are **major risk factors for atherosclerosis development**. Atherosclerosis of the coronary arteries results in CAD, commonly myocardial infarction and angina pectoris.
- Elevated plasma LDL levels can rise through an ↑ in VLDL or a ↓ in LDL catabolism.
  - ↑ VLDL arises from ↑ fatty acid delivery to the liver. This ↑ delivery can result from an ↑ in dietary fat or mobilization of fat stores.
  - ↓ LDL catabolism can arise from several factors, including an ↑ in dietary fat content. This downregulates LDL receptor expression.
- Low HDL is a major atherosclerosis risk factor because of the role of HDL in reverse cholesterol transport. Through this mechanism, HDL is secreted by the liver and removes cholesterol from peripheral tissues as it circulates throughout the body, exerting a positive effect on lipid balance in the body.

CAUSAL CONDITIONS

ASC box

Atherosclerosis

In atherosclerosis, changes in the blood vessel wall occur, which are characterized by lipid deposition and cell proliferation.

These changes can lead to narrowing of the vessel lumen and thrombus formation, causing a reduction in blood flow, and insufficient oxygen and nutrient delivery to affected organs.

CVS, cerebrovascular, and peripheral vascular disease can result from atherosclerosis of the heart, central nervous system, and extremities, respectively.

Hypercholesterolemia is a major risk factor for atherosclerosis development—particularly elevated LDL and low HDL levels.

APPROACH (Tables 3.23 and 3.24)

TABLE 3.23 • Different diagnosis of dyslipidemia

Mechanism	Differential Diagnosis
Elevated LDL	
Primary	Familial combined hyperlipidemia, familiar hypercholesterolemia
	Nonfamilial/polygenic
	Endocrine, renal disease, liver disease
Secondary	Drugs (e.g., thiazides)
	Obesity, cigarette smoking
HTg	
Primary	Familial HTg
Secondary	Obesity, diabetes, renal disease
	Drugs (estrogen, tamoxifen, b-blockers, glucocorticoids, cyclosporine, ethanol)
Low HDL	
Primary	Hypoalphalipoproteinemia, LCAT deficiency, Tangier disease
	Drugs (b-blockers, benzodiazepines, anabolic steroids)
Secondary	Obesity, inactivity, cigarette smoking

TABLE 3.24 • Targets of therapy for management of dyslipidemia

Risk Level	Initiate Treatment If	Primary Targets
High (FRS ≥ 20%) (CAD, PVD, atherosclerosis, most pts with DM)	Consider treatment in all	< 2 mmol/L LDL or > 50% reduction in LDL-C, apoB < 0.80 g/L
Moderate (FRS 10%–19%)	LDL-C < 3.5 mmol/L, TC/HDL-C ratio > 5.0, hs-CRP > 2 mg/L (men > 50 yr, women > 60 yr)	< 2 mmol/L LDL or > 50% reduction in LDL-C, apoB < 0.80 g/L
Low (FRS < 10%)	LDL-C < 5.0 mmol/L	> 50% reduction in LDL-C

History

- A screening fasting lipid profile is recommended for:
  - All men > 40 yr and postmenopausal women (or > 50 yr)
  - Children with a family history of hypercholesterolemia or chylomicronemia
  - Adults with one or several of the following risk factors: diabetes, cigarette smoking, HTN, BMI > 27 kg/m^2, family history of premature CAD, signs of hyperlipidemia, evidence of atherosclerosis, connective tissue disease (RA, SLE, psoriasis), HIV on HAART, GFR < 60, erectile dysfunction
- Decisions about treatment initiation are based on a pt's overall 10-yr risk of CAD events (FRS), not just the fasting lipid profile
- **FRS**—provides **10-yr risk of CAD events** based on several factors (**age**, **gender**, **TC**, **HDL-C**, **systolic BP** [and whether BP is **treated**], **smoking status**, **diabetes** [included in newer risk calculators; previously assumed to be automatically high risk])
- **Reynolds risk score**—similar to FRS, but includes **high-sensitivity CRP** and **family history** of parent having an MI before 60 yr

Physical Exam

- Tendon xanthomas (hard deposits on Achilles tendon, elbows, hands—sign of high LDL-C)
- Eruptive xanthomas (papules on elbows/knees—sign of high TG-C)
- Xanthelasma (eyelid deposits)
- Corneal arcus (ring-like appearance on cornea; common in older adults)

Management

- Identify and treat secondary causes.
- All pts should be counseled about lifestyle measures (smoking cessation, diet low in fat and refined sugars, weight reduction/maintenance, daily exercise, stress management).
- Medications should be initiated immediately in high-risk pts, without waiting to assess response to lifestyle measures (Table 3.25).

TABLE 3.25 • Drugs used in the treatment of lipid abnormalities

Class	Effect on Plasma Lipids	Mechanism	Adverse Effects
HMG-CoA (e.g., **simvastatin**)	↓ LDL	Inhibits cholesterol synthesis Upregulates LDL receptors	Myopathy, hepatic dysfunction
Fibrates (e.g., **gemfibrozil**)	↓ Tg through VLDL	Inhibits VLDL production	Nausea, Abdo discomfort, gallstone, myopathy
Niacin	↓ LDL through VLDL ↓ LDL	Inhibits VLDL production	Flushing, hyperglycemia, pruritus, gout, elevated liver function enzymes
Bile acid-binding resins (e.g., **cholestyramine**)		Depletes bile acids Upregulates LDL receptors	Constipation, Abdo discomfort, may bind other drugs
Inhibitors of intestinal sterol absorption (e.g., **ezetimibe**)	↓ LDL	Prevents dietary cholesterol absorption	Reversible impairment in hepatic function

- Statins are the mainstay of therapy, based on a multitude of trials that have demonstrated consistent reductions in the risk of death, MI, and stroke. Higher doses of the more potent statins (atorvastatin or rosuvastatin) have been shown to have superior efficacy compared with lower doses or less potent statins.
- In both the primary and secondary prevention setting, a 1 mmol/L reduction in LDL results in a 21% reduction in major CV events.
- Consider treating all pts with established vascular disease (coronary, cerebrovascular, or peripheral artery disease) with the highest tolerable dose of a high-potency statin such as atorvastatin or rosuvastatin.

ABNORMAL HEART SOUNDS

MCC OBJECTIVE

Based on Objective #62 (Abnormal Heart Sounds and Murmurs) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Rationale

- Pathologic heart sounds are often a clue to underlying structural heart disease

APPLIED SCIENTIFIC CONCEPT

Heart Sounds

- S_1:
  - Loud in: mitral stenosis, prosthetic mitral valve, short PR interval
  - Soft in: mitral regurgitation, COPD, long PR interval
- S_2:
  - Loud in: HTN, aortic sclerosis, prosthetic aortic valve
  - Soft in: hypotension, severe aortic stenosis, HF/low cardiac output
- Split S_2 (typically heard at LUSB):
  - Normal (physiologic) splitting: pulmonary valve closure (P_2) sound is slightly delayed, occurring after aortic closure (A_2) during inspiration. Best heard in young, slim adults or children
  - Exaggerated splitting:
    - Delayed P_2: RBBB, pulmonary embolism
    - Early A_2: VSD, mitral regurgitation
  - Fixed, split S_2: ASD
  - Paradoxical split (P_2 before A_2): LBBB, RV pacemaker
- S_3:
  - A low pitched sound heard just after S_2, caused by a large volume of blood entering the ventricle in early diastole. Heard in: dilated cardiomyopathy with volume overload, mitral/tricuspid regurgitation, occasionally in young athletic pts with hyperdynamic hearts
- S_4:
  - A low pitched sound heard just before S_1, caused by late filling into a stiff ventricle. Heard in: left ventricular hypertrophy (from HTN or hypertrophic cardiomyopathy), ischemia, aortic stenosis

Extra Heart Sounds

- Ejection sound—high-pitched sound in early systole (after S_1), heard in pts with bicuspid aortic (or pulmonic) valves
- Opening sound—high-pitched sound in early diastole (after S_2), heard in pts with rheumatic mitral (or tricuspid) valve disease
- Mid-systolic click—high-pitched sound in mid-systole caused by bowing of a myxomatous mitral valve, heard in pts with mitral valve prolapse
- Pericardial friction rub—classically, a biphasic or triphasic scratching sound, with systolic and diastolic components, caused by pericardial inflammation and "rubbing" between the visceral and parietal pericardium. Best heard while having the pt lean forward

- Murmur—a sound caused by turbulent blood flow, which could be occurring between chambers of the heart or across a narrowed arterial vessel. Murmurs are graded according to their intensity (loudness) (see Table 3.26). Many murmurs are innocent (not indicative of pathology), especially systolic murmurs without accompanying heart sound abnormalities or physical exam abnormalities. See next section for classic descriptions of murmurs heard in specific conditions.

TABLE 3.26 • Six grades of intensity of murmur

Grade I	Very faint, heard only when listener has "tuned in"
Grade II	Also faint, but can be identified after placing stethoscope on chest
Grade III	Moderately loud
Grade IV	Loud with palpable thrill
Grade V	Very loud, with thrill, may be heard when stethoscope is partly off the chest
Grade VI	Very loud, with thrill, heard without stethoscope

SYSTOLIC AND DIASTOLIC MURMURS

MCC OBJECTIVE

Based on Objectives #62 (Abnormal Heart Sounds and Murmurs) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Rationale

- Heart murmurs may be indicative of serious valvular heart disease or congenital heart disease. On the other hand, many murmurs (especially systolic murmurs without accompanying heart sound abnormalities or physical exam abnormalities) are innocent. Diastolic murmurs are almost always pathologic.

APPLIED SCIENTIFIC CONCEPT

- See Figure 3.12

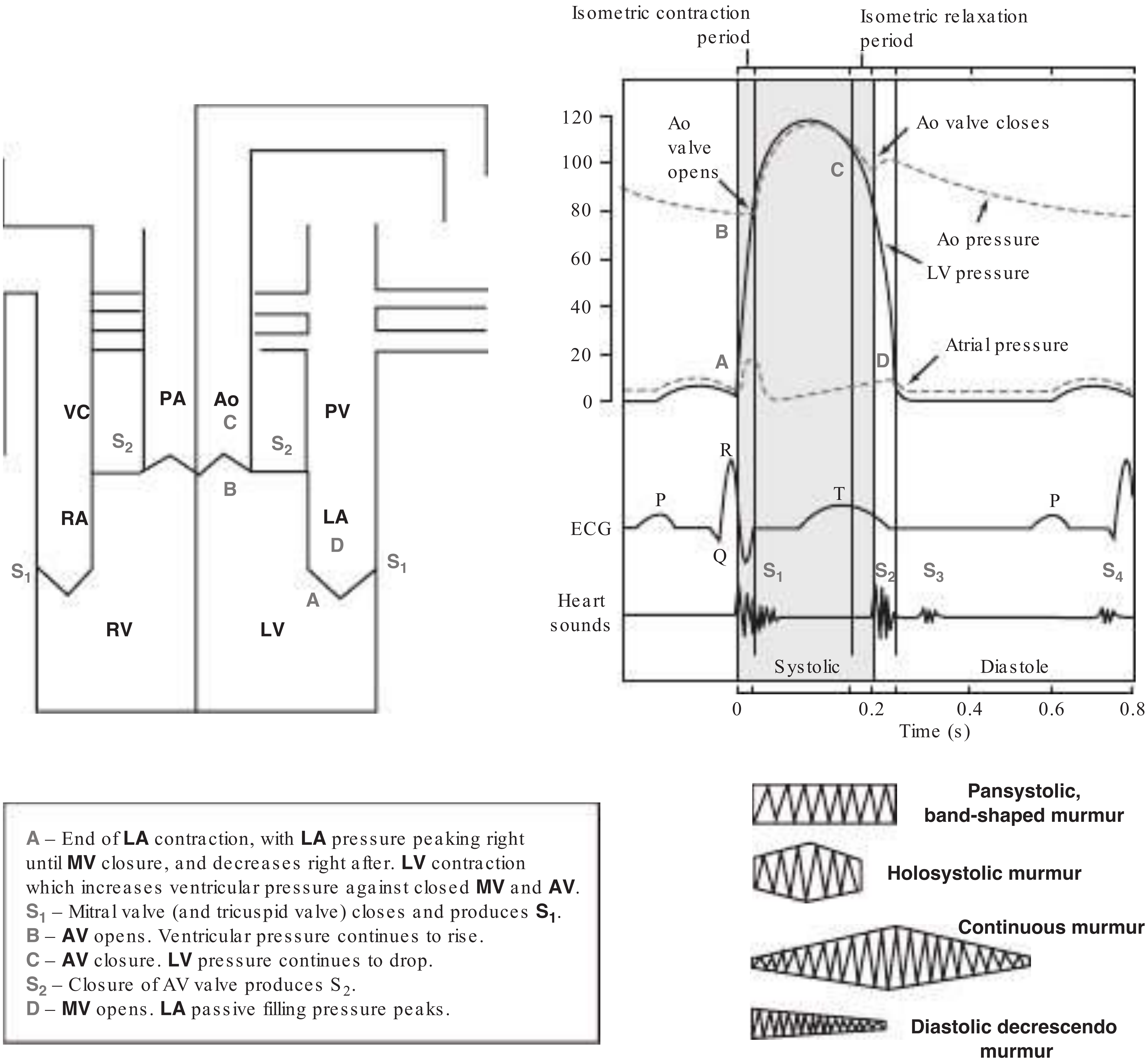
APPROACH

History

- Cardiac history:
  - Hx of congenital heart disease, murmur noted in childhood, prior heart surgery
  - Hx of MI or HF, infective endocarditis, family history of cardiomyopathy
- Prior infections:
  - Hx of rheumatic fever, STDs (tertiary syphilis may cause aortitis), infective endocarditis
- Comorbidities:
  - Inflammatory diseases (SLE, scleroderma), Marfan syndrome (MVP, aortic regurgitation), Down syndrome (AVSD), rheumatologic disease (RA, ankylosing spondylitis)

Physical Exam

- A complete cardiac examination should include the following components:
  - Inspection:
    - **General inspection and JVP**: inspect for surgical scars, pacemaker insertions, pt comfort/distress, peripheral edema/ascites, and JVP (a- or v-wave dominance, height, Kussmaul sign, response to hepatojugular reflux)
  - Palpation:
    - **Peripheral pulses and central pulse**: rate, rhythm, amplitude, contour, upstroke (see section on Abnormal Pulse)
    - **Precordium**: palpate along all four cardiac posts (see below) for thrills (palpable heart murmurs) and in left parasternal area for a systolic heave (typically noted in right ventricular enlargement or pulmonary HTN)



A – End of **LA** contraction, with **LA** pressure peaking right until **MV** closure, and decreases right after. **LV** contraction which increases ventricular pressure against closed **MV** and **AV**.
S_1 – Mitral valve (and tricuspid valve) closes and produces S_1.
B – **AV** opens. Ventricular pressure continues to rise.
C – **AV** closure. **LV** pressure continues to drop.
S_2 – Closure of AV valve produces S_2.
D – **MV** opens. **LA** passive filling pressure peaks.

Figure 3.12. Heart sounds.

- **Apex beat**: The apex beat is the most inferolateral cardiac impulse palpated on the chest; it should be in the 4th intercostal space, in the left midclavicular line. An apex beat that is inferior or lateral to this is displaced, indicating left ventricular enlargement. A sustained impulse (lasting longer than the ejection phase noted at the carotid artery) indicates left ventricular hypertrophy.

- Auscultation:
  - **Heart sounds**: The intensity (loudness) of S_1 and S_2 and the presence of additional heart sounds should be determined (see section on Heart Sounds).
  - **Characterization of heart murmurs**: Auscultation is carried out using the diaphragm of the stethoscope at all cardiac posts (Figure 3.13) and at the apex using the bell of the stethoscope. Murmurs are described according to the following:
    - – Intensity (loudness, out of 6—see section on Heart Sounds)
    - – Timing (early, mid, or late in systole/diastole)
    - – Shape (systolic—crescendo/decrescendo, holosystolic, click murmur) (diastolic—decrescendo) (continuous)

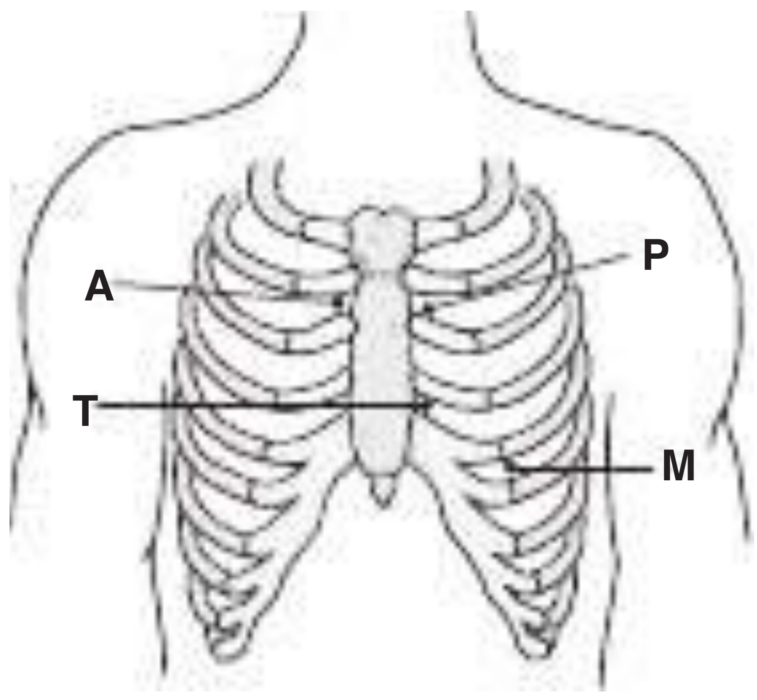


Figure 3.13. Site of auscultation.

  - Location (aortic, pulmonic, tricuspid, mitral area or alternatively LUSB, apex, etc.)
  - Radiation (carotids, apex, back)
  - Pitch (low pitch—heard with bell, high pitch—heard with diaphragm)
  - Quality (harsh, blowing, rumbling, musical)
  - Dynamic maneuvers (handgrip, squat-to-stand, valsalva)

Investigations (Figure 3.14)

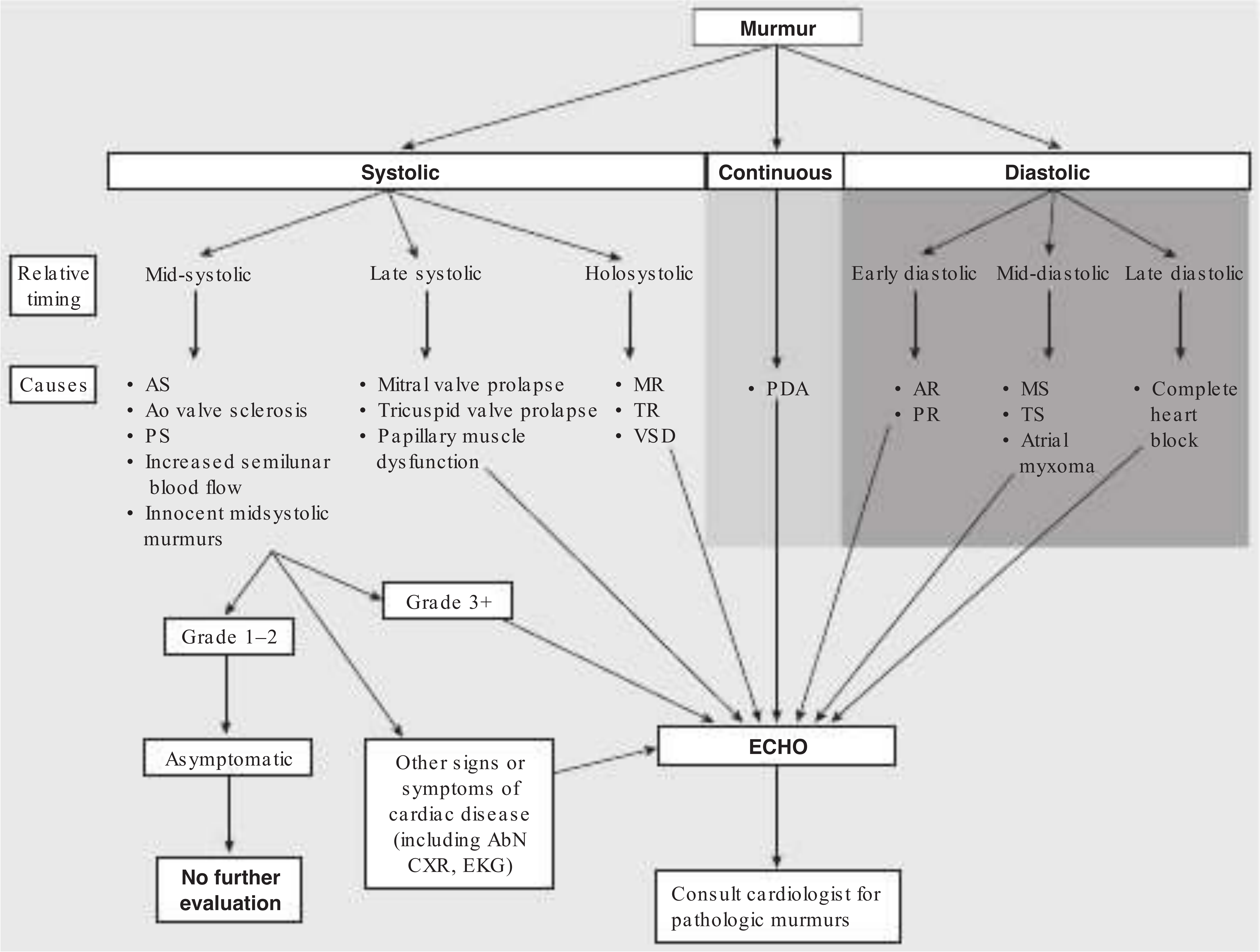


Figure 3.14. Approach to murmurs.

C2 L E O

Physicians' Legal Liability for Negligence (Civil Liability in Québec)

Physicians are legally liable to their pts for causing harm through a failure to meet the standard of care that is applicable under the particular circumstances under consideration. A physician may be found legally liable to pt if a diastolic or systolic murmur, when associated with other cardiac findings, was considered innocent and not investigated or referred for further assessment.

- Echocardiogram—recommended for all new systolic murmurs of grade 3/6 severity or greater, all diastolic murmurs, and all murmurs with other signs/symptoms of cardiac disease
- CXR, ECG, cardiac catheterization—as directed by physical exam and echocardiogram

Management

- The definitive management of most congenital and valvular heart conditions is surgical (see Table 3.27), and medical management generally consists of avoidance of drugs that may worsen the condition, volume management (diuresis for volume overload), and palliative care (if surgery is not an option) (see Table 3.28).

TABLE 3.27 • General guidelines for surgical referral in common valvular and congenital heart diseases

Condition	Guidelines for Consideration of Surgical Referral
Aortic stenosis	Severe AS (AVA < 1.0 cm^2) + symptomatic or progressive LV failure (EF < 50%) or undergoing concurrent open heart surgery (CABG)
Aortic insufficiency	Severe AI + progressive LV dilation (ESD > 55 mm, EDD > 75 mm), failure (EF< 50%) or symptomatic
Mitral regurgitation	Severe MR + progressive LV dilation (ESD 40–55 mm), failure (EF 30%–60%) or symptomatic
Mitral stenosis	Symptomatic, pulmonary HTN or severe MS
ASD, partial AVSD	L–R shunt > 2:1, right heart volume overload
VSD	L–R shunt > 2:1, LV dilatation/failure
Pulmonary stenosis	Peak gradient > 50 mm Hg (mean > 30 mm Hg) + symptoms or peak gradient > 60 mm Hg (mean 40 mm Hg) without symptoms
PDA	All audible PDAs should be closed
Ebstein anomaly (TV ≥ 2 cm toward apex c/w MV)	At least moderate tricuspid regurgitation + symptomatic
Coarctation of the aorta	Gradient > 20 mm Hg and HTN (> 140/90)

TABLE 3.28 • Common causes of heart murmurs in adults

Condition	Etiology	Symptoms	Physical Exam	Investigations	Management
Mitral stenosis	**Rheumatic heart disease** Calcification of leaflets	Malar flush, AF, CHF	• Mid-diastolic rumbling after OS at apex • Loud P$_2$ • OS after S$_2$ • Low pitch, tapping apex beat, thrill • LLD position increases murmur	**ECHO**: Doppler studies to measure transmitral gradient **R heart cath**: measure pulmonary pressures, PCWP **CXR**: LA, LV enlargement **ECG**:P mitrale, ± AF	**Medical**: b-blocker and diuretics **Anticoagulation** if AF present **Surgical**: balloon valvoplasty (if free from severe regurgitation or calcification)
Mitral regurgitation	**Myxomatous degeneration** Ischemic heart disease infective endocarditis Rheumatic heart disease Dilatation of the LV	CHF (SOB, fatigue, leg edema, pulmonary edema, orthopnea, PND)	• High pitch, holosystolic murmur at apex • Radiates to axilla • Laterally displaced apex beat, parasternal heave • Increases with handgrip	**ECHO:** color Doppler flow shows backflow from LV to LA **ECG:** P mitrale, LVH, ± AF **CXR:** LA, LV enlargement **Cath:** can quantify regurgitation with LV contrast injection	**Acute/hypotensive**: IABP and surgery **Normotensive**: Nitroprusside, ACEI, and hydralazine **Anticoagulation** if AF **Surgery**: repair vs. replacement
Mitral valve prolapse	**Myxomatous degeneration** (Genetic variants of fibrillin, elastin, collagen I and II) 2% prevalence, F:M is 3:1.	Usually asymptomatic, may lead to MR	• Mid-systolic click • Late systolic murmur	**ECHO**: thickened prolapsing valve ± mitral regurgitation anatomy, regurgitant flow **ECG**: PACs, PVCs	No treatment required unless mitral regurgitation

(Continued)

TABLE 3.28 • Continued

Condition	Etiology	Symptoms	Physical Exam	Investigations	Management
Aortic stenosis	**Calcification of aortic valve** Bicuspid aortic valve Rheumatic heart disease	Angina, CHF, syncope/SCD	• Mid-systolic, crescendo-decrescendo murmur at LUSB, radiating to carotids • Weak pulse with slow upstroke (pulsus parvus and tardus) • Soft S_2 • Sustained apical beat	**ECHO:** measure transaortic gradient **Cath**: measure pullback gradient across aortic valve **EKG**: LVH **CXR**: cardiomegaly	Avoid afterload reducers (fixed afterload from AS) and b-blockers (fixed stroke volume, so may depend on HR for CO) **Surgery**: valve replacement (consider transcatheter valve if poor surgical candidate)
Hypertrophic cardiomyopathy	**Mutation in genes that code for characteristics of heart muscle**	Angina, CHF, syncope/SCD	• Mid-systolic crescendo-decrescendo murmur at LUSB • Biphasic pulse • Increases with standing (from squat)	**ECHO**: shows severe global or regional (septal, or rarely apical) hypertrophy **ECG**: LVH, Q waves, T-wave abnormalities **Holter, exercise stress test:** can help risk stratify	**Medical** : b-blockers, avoid competitive sports **Anticoagulation** if AF **ICD** - if high risk of SCD **Surgery**: Septal ablation (EtOH) or myomectomy if refractory symptoms
Aortic insufficiency	**Aortic root dilatation** (Marfan, HTN, idiopathic) Bicuspid aortic valve Aortic dissection Syphilis	Angina, CHF	Three murmurs: high-pitched, blowing decrescendo diastolic murmur at LLSB; mid-systolic murmur at the base; Austin Flint—low pitched	**ECHO**: regurgitant flow from aorta to LV, LV dilated **ECG**: LAD, LVH **Cath:** can quantify regurgitation with aortic root contrast injection	**Acute/hypotensive:** Inotropes (dobutamine) ± vasodilators (nitroprusside) **Chronic:** b-blockers (if Marfan), vasodilators (hydralazine, nifedipine, ACEI), diuretics ± digoxin **Surgery**: valve and/or root replacement

PALPITATIONS

MCC OBJECTIVE

Based on Objectives #68 (Palpitations) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Definition

- An unpleasant awareness of the heartbeat. May be further characterized as rapid, forceful, or irregular

Rationale

- Palpitations are a common, subjective sensation that is often benign (PACs, PVCs). On the other hand, palpitations may occasionally be a sign of a more serious heart rhythm disturbance (SVT, atrial fibrillation, or even VT), and so a prompt evaluation is important.

APPLIED SCIENTIFIC CONCEPT

- Normal SA pacemaker function and impulse propagation:
  - Spontaneous depolarization of SA node
  - Atrial depolarization (P wave)
  - Impulse propagates slowly through AV node, with a normal delay in reaching His bundle (PR segment)
  - Impulse travels rapidly via Purkinje fibers of the bundle branches, reaching ventricular myocardium
- Mechanisms of arrhythmia:
  - Reentry (a perpetual loop/short circuit is formed, often due to an additional conduction pathway)
  - Automaticity (a focus other than the SA node spontaneously depolarizes)
  - Triggered activity/after depolarizations (oscillations in membrane voltage that occur after a preceding impulse, which may trigger depolarization) (see Figure 3.15)

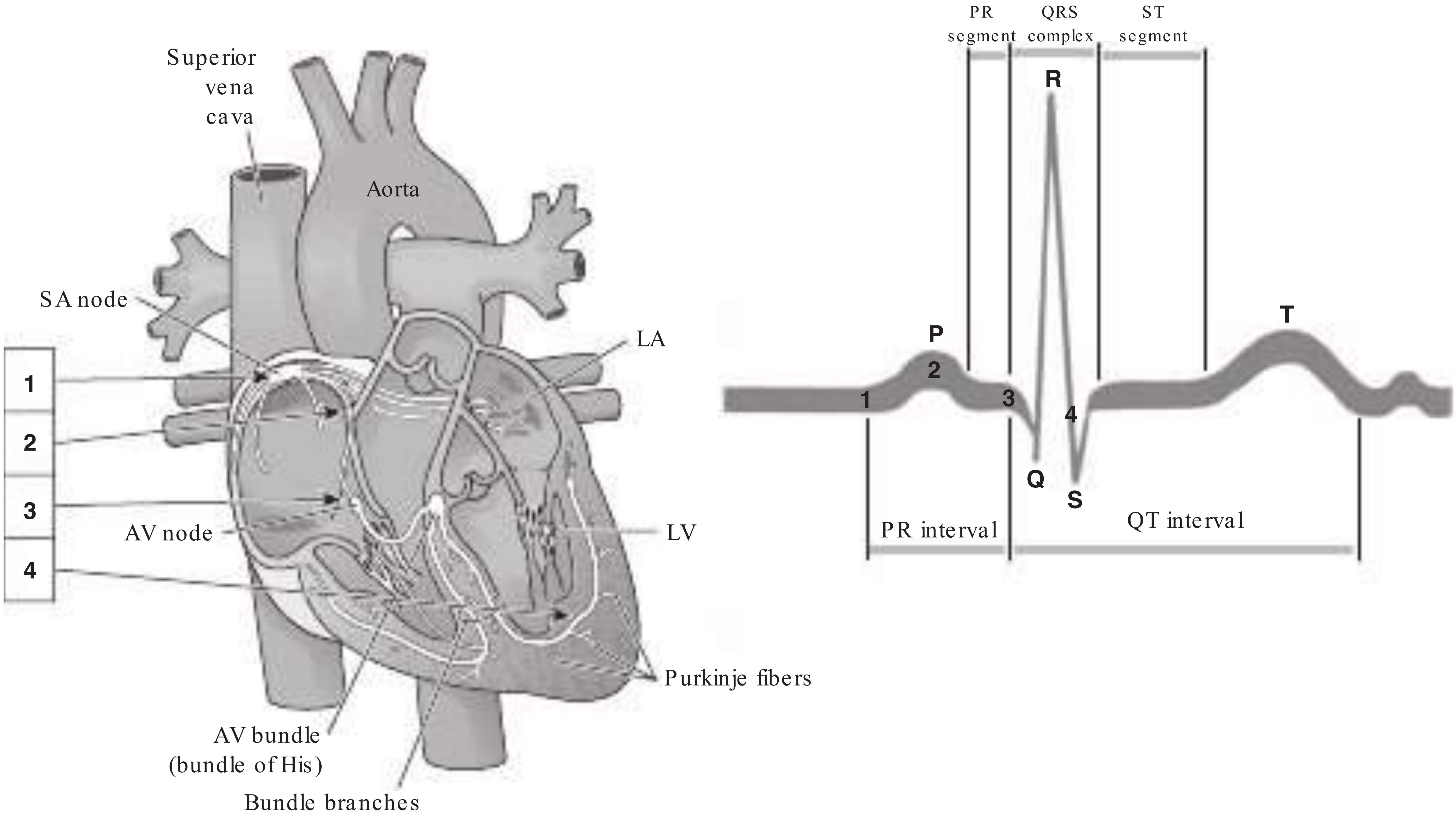


Figure 3.15. Cardiac electrophysiology.

CAUSAL CONDITIONS

- Cardiac (50%):
  - **Arrhythmias**: SVT, PACs, or PVCs
  - **Structural heart disease:** valvular disease, cardiomyopathy, shunts, myxoma
- Psychiatric (33%):
  - Anxiety disorder, panic disorder, stress, depression
- Endocrine:
  - Hyperthyroidism, hypoglycemia, pheochromocytoma
- Medications:
  - Caffeine, nicotine, sympathomimetics (decongestants, cocaine, stimulants)
- High output state:
  - Anemia, pregnancy, fever, exercise, Paget disease

ASC box

Palpitation

Role of autonomic system in development of arrhythmias:

1. Sympathetic stimulation of b_1 adrenergic receptors → ↑ SA node automaticity and ↑ rate of pacemaker depolarization → ↑ HR, for example, exercise, emotional stress
2. Parasympathetic stimulation through vagus nerve → ↓ pacemaker current → ↓ pacemaker firing rate → ↓ HR
3. Arrhythmias like SVT and ventricular tachyarrhythmia can occur during catecholamine excess such as during exercise or at times of stress.

APPROACH

History

- Age of onset, description of palpitations (forceful beats, heart racing, irregular, sudden onset/offset vs. gradual), Hx of cardiac disease, associated symptoms (syncope, chest pain, and dyspnea), psychiatric illness, medications (including OTC), drugs, and caffeine

Physical Exam

- Vitals
- Cardiac exam—focusing on JVP, heart sounds, and the presence of murmurs

Investigations

- ECG—rhythm strips and 12-lead ECG of tachycardia if possible (see Figures 3.16–3.21)
- Labs—CBC, electrolytes, TSH—to R/O anemia, hypo/hyperkalemia, hyperthyroidism

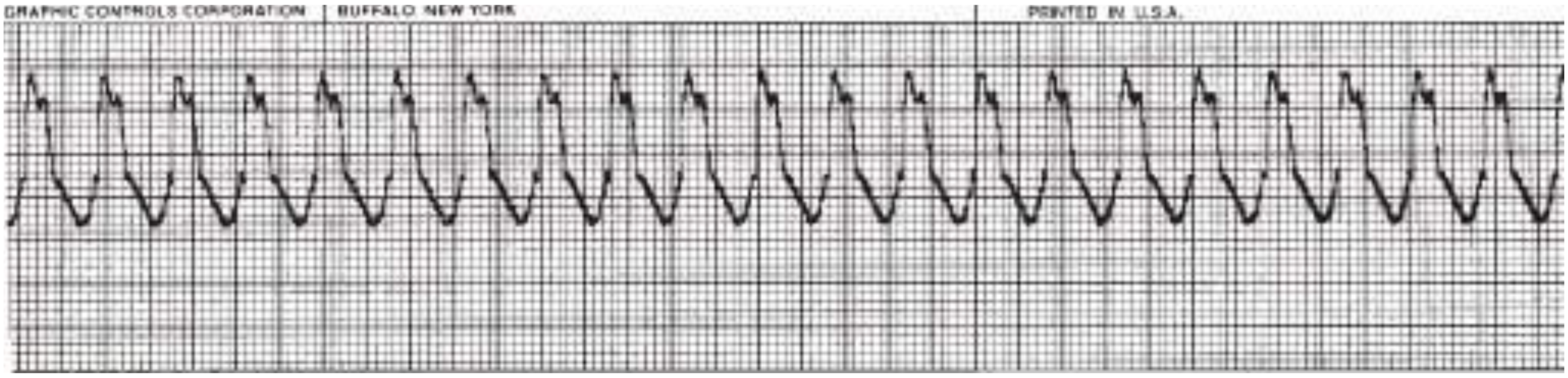


Figure 3.16. Ventricular tachycardia.
(Reprinted with permission from Smeltzer SC, Bare BG. *Textbook of Medical-Surgical Nursing*. 9th ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2000.)

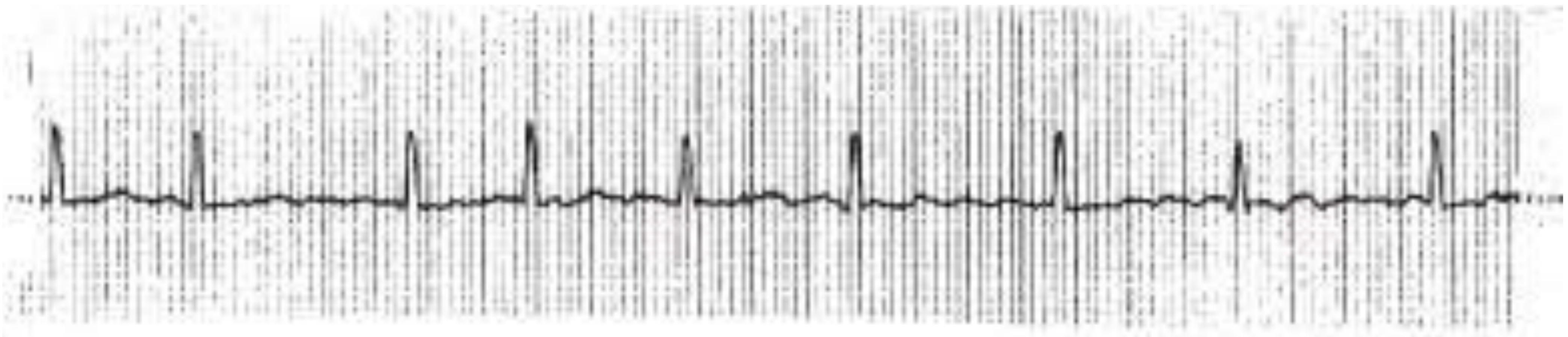


Figure 3.17. Atrial fibrillation.
(Reprinted with permission from Lilly LS. *Pathophysiology of Heart Disease*. 5th ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2010.)

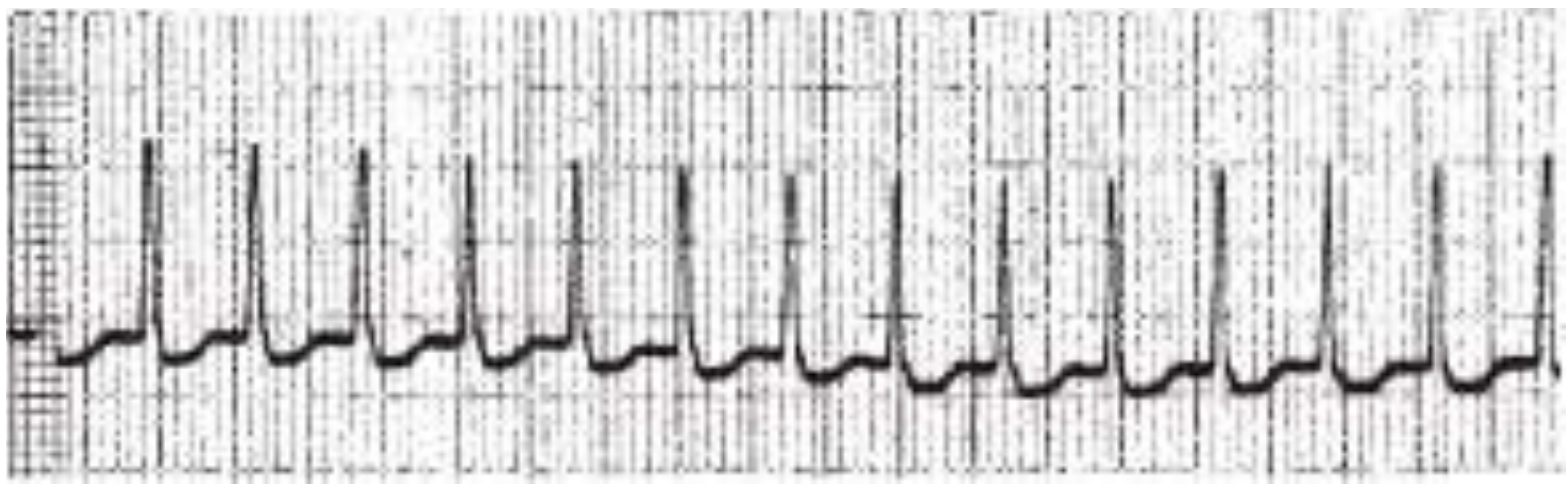


Figure 3.18. Paroxysmal SVT, PSVT (likely AVNRT).
(Reprinted with permission from Lilly LS. *Pathophysiology of Heart Disease*. 5th ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2010.)

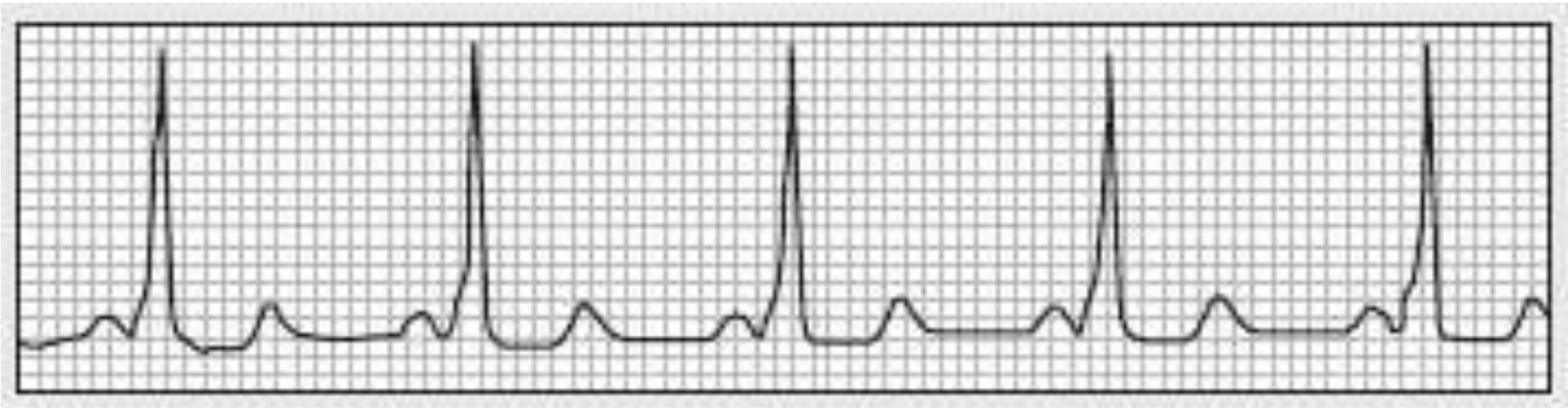


Figure 3.19. Preexcitation (Δ wave) on resting ECG (may be prone to AVRT type PSVT).

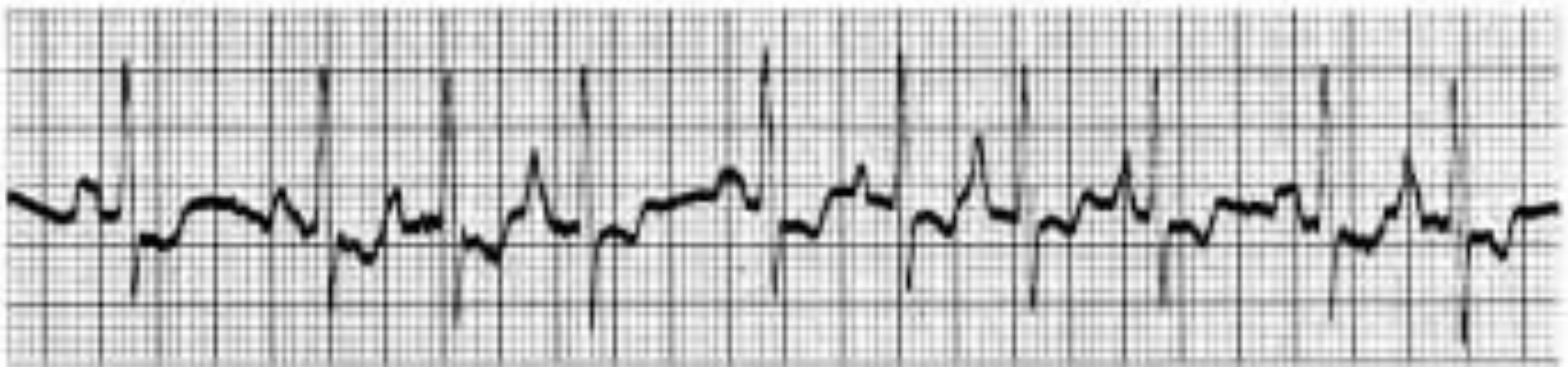


Figure 3.20. Multifocal atrial tachycardia.
(Modified with permission from Lilly LS. *Pathophysiology of Heart Disease*. 5th ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2010.)

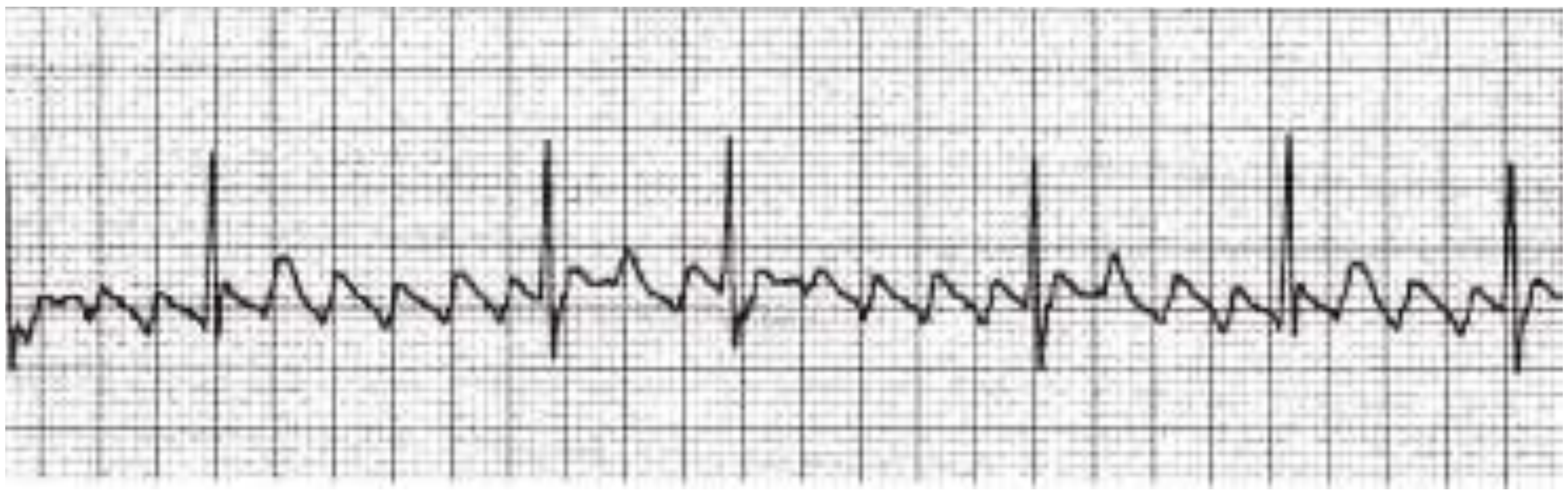


Figure 3.21. Atrial flutter.
(Modified with permission from Lilly LS. *Pathophysiology of Heart Disease*. 5th ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2010.)

- Consider transthoracic echo to R/O structural heart disease
- If diagnosis unclear, try to capture event using ambulatory monitoring (24–48 h Holter monitor, event monitor)

Management

- Cardiac:
  - Determine rhythm and treat accordingly (see Table 3.30 and Figures 3.22 and 3.23)
- Noncardiac:
  - Reassurance, conservative measures (stimulant, nicotine, excess caffeine avoidance), correct any electrolyte disturbances, psychiatric treatment/referral as needed

TABLe 3.30 • Management of palpitations/arrhythmias

Rhythm	Acute Rx	Long-term Rx
Unstable (VT, VF, rarely AF/SVT)	Defibrillation or cardioversion	AICD for unstable VT or VF
VT (stable) SVT	12-lead ECG, then cardioversion	As directed by a cardiologist (meds, RF ablation, or ICD)
Sinus tachycardia	Treat underlying cause	N/A
Ectopic atrial tachycardia	b-Blocker or CCB	b-Blocker, CCB RF ablation if meds fail
PSVT (AVNRT or AVRT)	Vagal maneuvers, adenosine	b-Blockers, CCB if no accessory pathway (delta wave) RF ablation
Atrial fibrillation	b-Blockers, CCB, digoxin Rarely cardioversion if unstable	Anticoagulation for most pts (see Clinical Box) Rate control: b-blockers, CCB, digoxin or rhythm control: antiarrhythmics ± RF ablation

(Continued)

TABLe 3.30 • Continued

Rhythm	Acute Rx	Long-term Rx
Atrial flutter	b-Blockers, CCB, digoxin	b-Blockers, CCB, ± digoxin RF ablation often needed, as HR control can be difficult
Multifocal atrial tachycardia	b-Blockers or CCB	b-Blockers or CCB RF ablation of AV node + pacemaker if meds fail

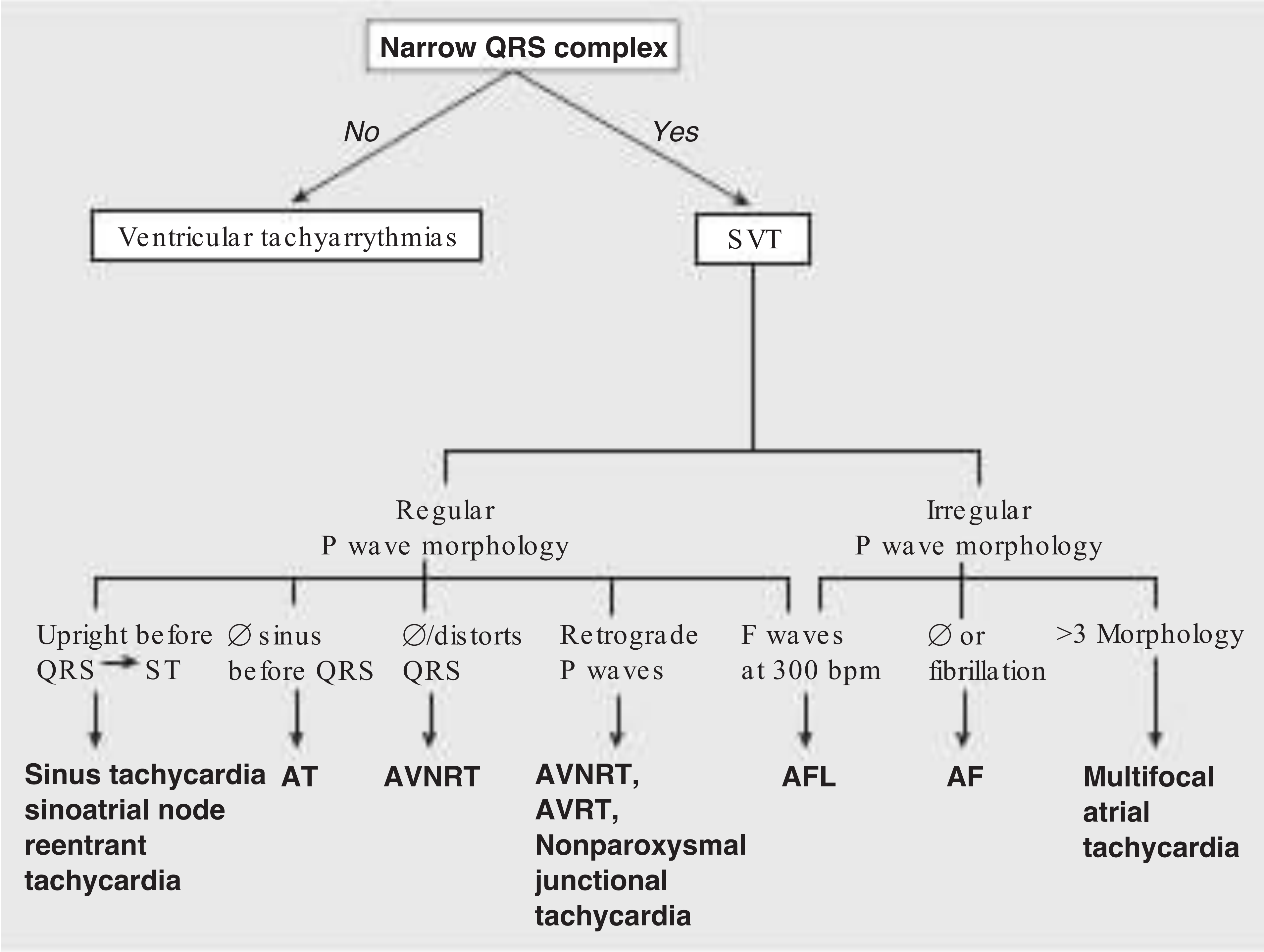

Narrow QRS complex
No
Yes
Ventricular tachyarrythmias
SVT
Regular P wave morphology
Irregular P wave morphology
Upright before QRS → ST
∅ sinus before QRS
∅/distorts QRS
Retrograde P waves
F waves at 300 bpm
∅ or fibrillation
>3 Morphology
Sinus tachycardia sinoatrial node reentrant tachycardia
AT
AVNRT
AVNRT, AVRT, Nonparoxysmal junctional tachycardia
AFL
AF
Multifocal atrial tachycardia

Figure 3.22. SV arrhythmias.

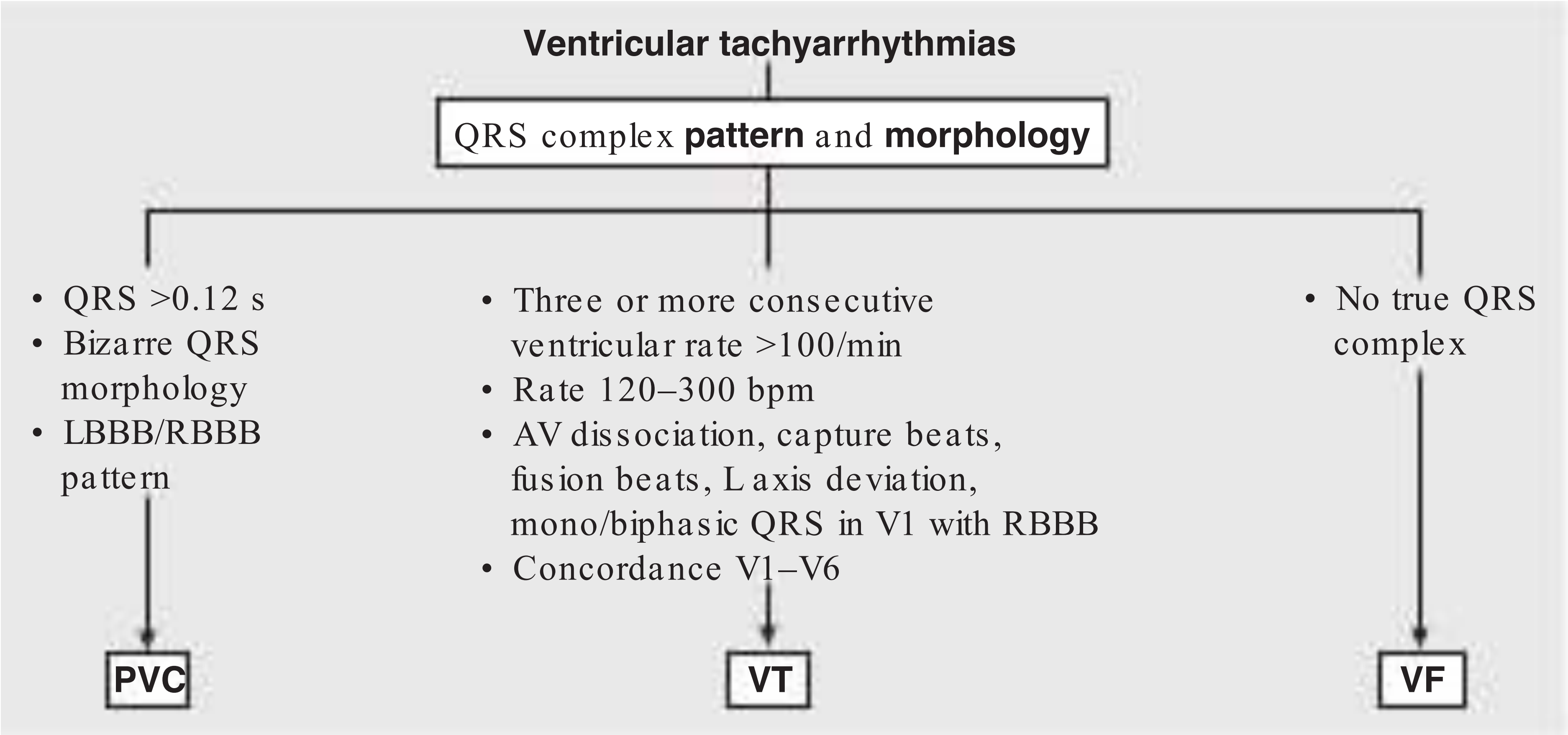

Ventricular tachyarrhythmias
QRS complex pattern and morphology
• QRS >0.12 s
• Bizarre QRS morphology
• LBBB/RBBB pattern
• Three or more consecutive ventricular rate >100/min
• Rate 120–300 bpm
• AV dissociation, capture beats, fusion beats, L axis deviation, mono/biphasic QRS in V1 with RBBB
• Concordance V1–V6
• No true QRS complex
PVC
VT
VF

Figure 3.23. Ventricular tachyarrhythmias.

CLINICAL box

Atrial fibrillation

Atrial fibrillation is a common arrhythmia and present in 1% of Canadians (5% over 65 yr, 15% over 85 yr), it may cause fatigue/palpitations, HF (if HR is persistently over 110 bpm), and stroke (responsible for 20% of strokes).

- *Acute cardioversion*—if duration is > 48 h or uncertain, cardioversion has a 2%–5% chance of precipitating a CVA (due to thrombus formation in left atrial appendage). Anticoagulation for 3 to 4 wk or trans-esophageal echo (to visualize LAA) is advised unless cardioversion is urgently required.
- *Long-term rate control versus rhythm control*—no difference in risk of death or stroke with either strategy, but rhythm control therapies (antiarrhythmics, radiofrequency ablation) have a greater risk of serious side effects, so they are best reserved for pts with symptoms refractory to rate control.
- *Long-term anticoagulation*—most pts with atrial fibrillation require long-term anticoagulation (with warfarin, dabigatran, rivaroxaban, or apixaban) to prevent stroke. Stroke risk in nonvalvular AF varies between 2% and 15% per year (according to the CHADS$_2$ score—Table 3.29). Oral anticoagulation is recommended for CHA2DS2-VASc score of 2 or greater (should be considered in men with scores 1 or greater). Daily ASA is recommended for pts who are not receiving chronic anticoagulation, but only reduces the risk of stroke by 20%–30%.

TABLE 3.29A • CHADS$_2$ score for estimating yearly CVA risk in AF

Risk Factor	Points
CHF	1
HTN	1
Age > 75 yr old	1
Diabetes mellitus	1
Hx of stroke	2

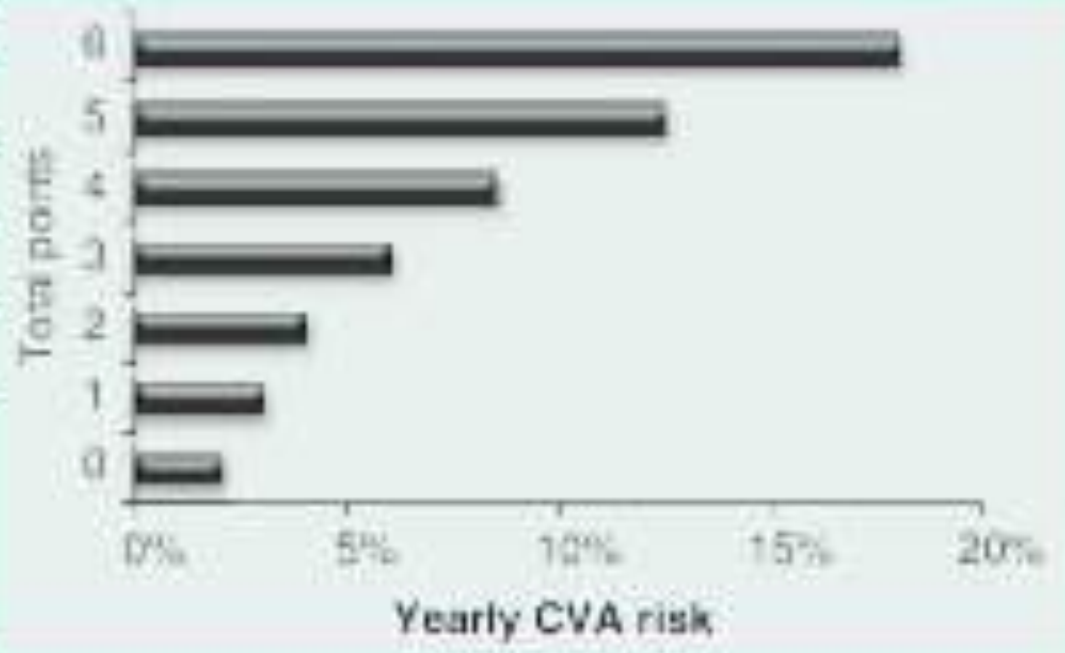
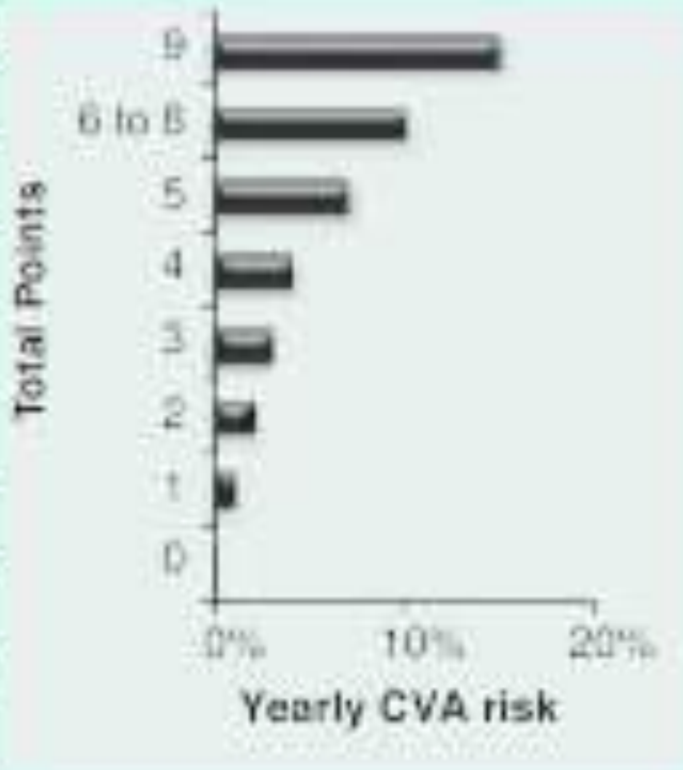


TABLE 3.29B • CHADSVASC score for estimating yearly CVA risk in AF

Risk Factor	Points
CHF	1
HTN	1
Age 65–75 yr old	1
Age > 75 yr old	2
Diabetes mellitus	1
Stroke (or TIA)	2
Vascular disease (MI, PAD, aortic plaque)	1
Sex (female)	1
Total points	9



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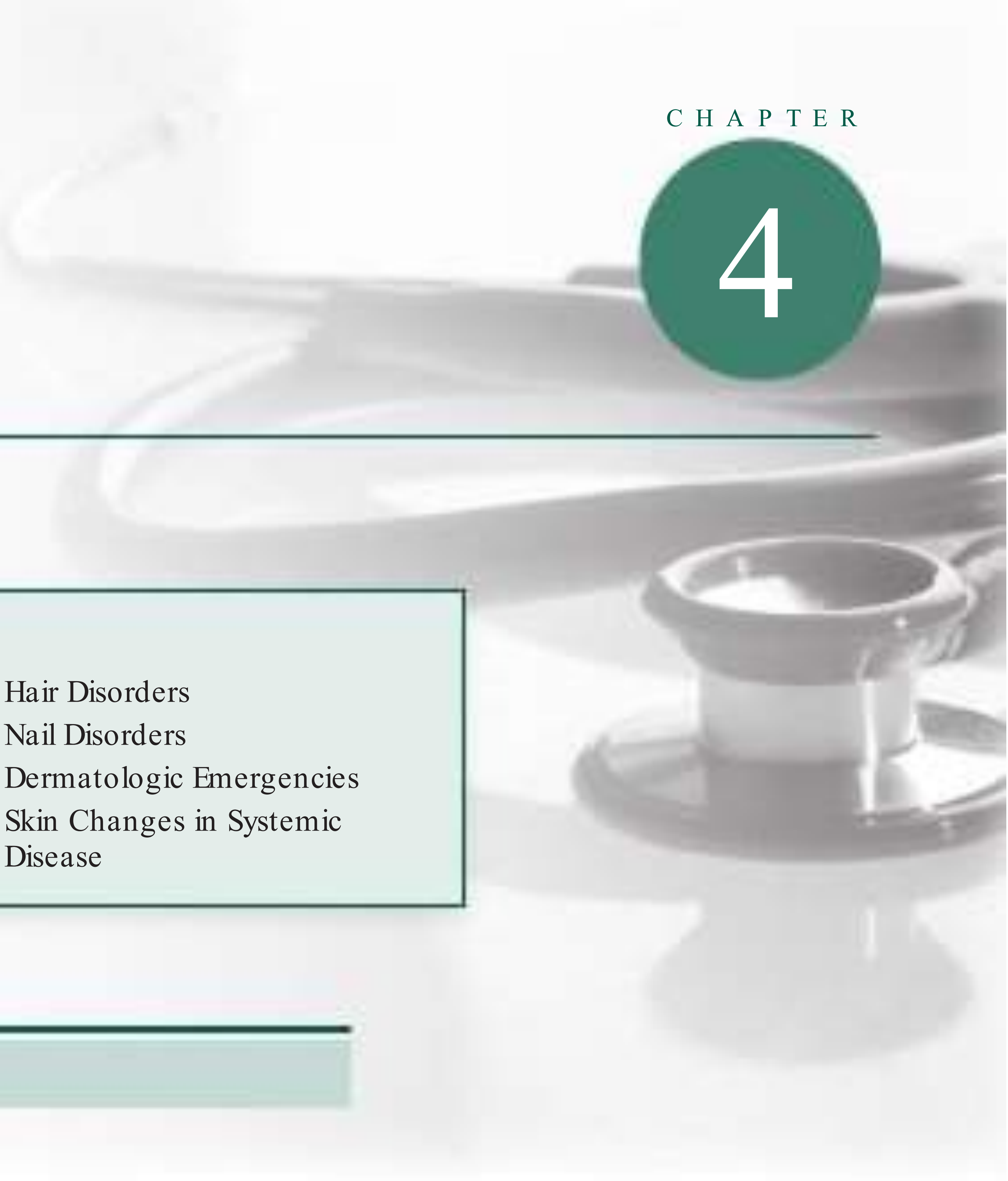

CHAPTER

4

Dermatology*

Bez Toosi • Sonja Gill • Nisha Mistry

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Hair Disorders
Nail Disorders
Dermatologic Emergencies
Skin Changes in Systemic Disease

SKIN RASH, MACULES

MCC OBJECTIVE

Based on Objective #97 (Skin Rash/Papules) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Macules are < 1 cm flat discolored lesions.

Primary Lesions (Table 4.1)

TABLE 4.1 • Primary lesions

Macule	< 1 cm flat discolored lesion
Patch	> 1 cm flat discolored lesion
Papule	< 1 cm palpable raised lesion
Plaque	> 1 cm palpable raised lesion
Nodule	< 1 cm lesion with significant depth
Tumor	> 1 cm lesion with significant depth
Cyst	> 1 cm fluid-containing lesion
Telangiectasia	Dilated superficial blood vessels
Pustule	Elevated lesion containing pus
Vesicle	< 1 cm elevated lesion containing serous fluid
Bulla	> 1 cm elevated lesion containing serous fluid
Wheal	Transient blanchable papule or plaque

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*This chapter should be used as a guide. The reader may find it beneficial to use a second source (such as an internet search engine) to refer to images and further descriptions of the conditions mentioned in the text.

Secondary Lesions (Table 4.2)

TABLE 4.2 • Secondary lesions

Excoriation	Scratch mark on the skin
Lichenification	Area of diffuse thickening with increase in surface skin markings due to rubbing or scratching
Scales	Increased stratum corneum cells shedding
Crusts	Dried exudates of blood, serum, or pus
Fissure	Linear break in the skin
Erosion	Shallow complete or partial loss of the epidermis, heals without scarring
Ulceration	Irregular excavations extending into the dermis or deeper
Atrophy	Thinning or depression of the skin
Scar	Connective tissue formations that replace lost tissue
Hypopigmentation	Decreased skin pigment
Hyperpigmentation	Increased skin pigment
Depigmentation	Complete absence of skin pigment

CAUSAL CONDITIONS

Erythematous Macules

Possible Causes
- Drug eruption
- Infectious exanthems
- Secondary syphilis (palms and soles)
- Rheumatic fever (erythema marginatum)
- RMSF (early stages, sparing palms and soles) (see Clinical Box)

Location
- Trunk and proximal extremities

Lesions
- Blanchable and diffuse

CLINICAL box

RMSF is a serious illness caused by the tick-borne bacterium, Rickettsia rickettsii. The disease frequently presents as a sudden onset of fever, headache, and rash, with a history of tick bite. It is important to note, however, that the tick bites are generally painless and may not be reported by all patients. Additional nonspecific symptoms such as myalgia and gastrointestinal complaints may also be reported. If not treated correctly, RMSF can lead to serious irreversible damage to internal organs and death.

Additional information regarding how to diagnose RMSF, despite its nonspecific symptoms, can be found in the following article: Masters EJ, Olson GS, Weiner SJ, et al. Rocky Mountain spotted fever: a clinician's dilemma. *Arch Intern Med.* 2003;163(7):769–774.

Photodistributed Macules

Drug Photosensitivity Reactions (Table 4.3)

TABLE 4.3 • Phototoxic versus photoallergic drug reactions

	Phototoxic Drug Reaction	Photoallergic Drug Reaction
Common agents	NSAIDs, quinolones, tetracyclines, amiodarone, phenothiazines	Soaps, fragrances; caused by interaction of photoallergen and UVA
Location	Face, "V" of upper chest, dorsa of hands and forearms, sun-exposed areas	
Prevalence	More common	Less common
Clinical presentation	Presents as an exaggerated sunburn: erythema, edema, vesicles/bullae	Pruritic eruption indistinguishable from allergic contact dermatitis
Dose dependency	Dose related	Triggered at any dose

Collagen/Vascular

SLE Lesions (Figure 4.1)
- Erythema in malar distribution (**butterfly rash**) or
- Diffuse erythema in photodistribution

Dermatomyositis Lesions (Figure 4.2)
- Violaceous, periorbital **heliotrope rash** with edema
- Erythema of neck and upper trunk (**shawl sign**)
- Violaceous papules over knuckles (**Gottron papules**)

Hypopigmented Macules

Tinea Versicolor (Pityriasis Versicolor) (Figure 4.3)

- Associated with overgrowth of *M. furfur*

Lesions

- Mottled distribution of round/oval hyper- or hypopigmented macules with fine scaling (positive grattinage)
- Most commonly found on the trunk

Diagnosis

- Hyphae and spores seen on KOH prep (**"spaghetti and meatballs"**)

Treatment

- Selenium sulfide lotion
- Oral ketoconazole

Vitiligo

- An autoimmune reaction against melanocytes; associated with other autoimmune diseases, including pernicious anemia, Hashimoto thyroiditis, and diabetes mellitus type 1

Lesions

- Acquired depigmented macules or patches with sharp margins
- May be isolated or generalized
- Typically around the eyes, mouth, on digits, extensor surfaces, low back, and genitalia

Diagnosis

- Wood lamp to distinguish hypopigmentation from depigmentation
- Absence of melanocytes on histology and microscopy
- Lab tests if thyroid disease, diabetes, or pernicious anemia suspected

Treatment

- Sun protection (including sunscreens)
- Camouflage preparations
- Repigmentation with narrow-band UVB and topical corticosteroids or topical immunomodulators
- Depigmentation for extensive disease using topical depigmenting agents on normally pigmented skin

Hyperpigmented Macules

Postinflammatory Hyperpigmentation

Common Causes

- Following acne, psoriasis, lichen planus, atopic dermatitis, or any type of trauma

Lesions

- Usually limited to site of inflammation
- Indistinct borders
- Occurs especially in darker skin types

Treatment

- Observation (almost all cases will resolve spontaneously)

Melasma

- Affects females more than males

Common Causes

- Sun exposure
- Triggered by pregnancy and exogenous hormone therapy

Lesions

- Acquired well-demarcated geographic-patterned macules and patches with irregular margins
- Most commonly on the central face (cheeks, forehead, nose, upper lip) (Figure 4.4)

Treatment

- May regress spontaneously
- Skin-lightening agents: hydroquinone, azelaic acid, tretinoin, kojic acid
- Chemical peels
- Sun protection

Fixed Drug Eruption

- An adverse drug reaction

Lesions

- Sharply marginated, round/oval, erythematous macules evolving to plaques, bullae, and erosions; recurrent episodes may leave prominent hyperpigmented macules or patches

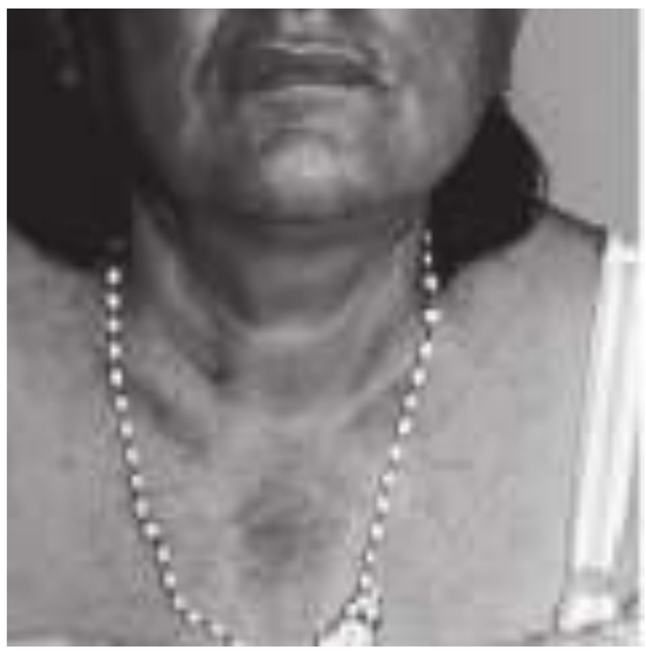

Figure 4.1. SLE. Note the "V" photodistribution of the upper chest.
(From Goodheart HP. *Goodheart's Photoguide of Common Skin Disorders: Diagnosis and Management.* 2nd ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2003.)

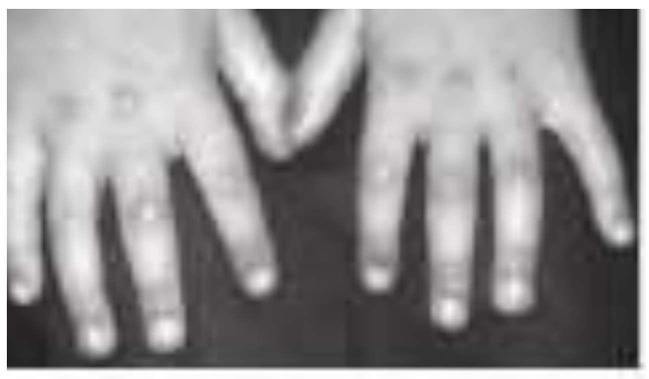

Figure 4.2. Dermatomyositis. Gottron papules are violaceous, flat-topped papules located over the joints of the fingers.
(From Goodheart HP. *Goodheart's Photoguide of Common Skin Disorders: Diagnosis and Management.* 2nd ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2003.)

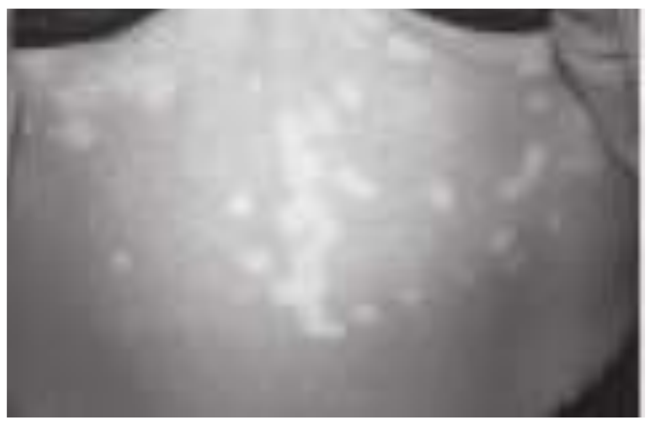

Figure 4.3. Tinea versicolor. Oval hypopigmented macules that are accentuated in the summer with tanning and can resemble vitiligo.
(From Goodheart HP. *Goodheart's Photoguide of Common Skin Disorders: Diagnosis and Management.* 2nd ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2003.)

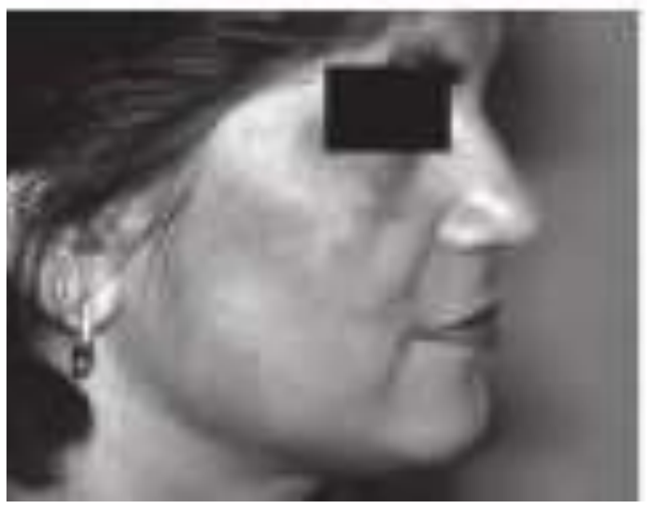

Figure 4.4. Melasma of the cheeks.
(From Goodheart HP. *Goodheart's Photoguide of Common Skin Disorders: Diagnosis and Management.* 2nd ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2003.)

- This drug eruption is "fixed" because it recurs at the same location(s) each time the drug is taken

Diagnosis

- Clinical; drug challenge/withdrawal

Treatment

- Stop offending agent

SKIN RASH, PAPULES

MCC OBJECTIVE

Based on Objective #97 (Skin Rash/Papules) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Papules are < 1 cm elevated circumscribed lesions

CAUSAL CONDITIONS (Table 4.4)

- Approach to conditions with red and scaly papules/plaques (Figure 4.5)
- Clinical presentation of conditions with red and scaly papules/plaques (Figure 4.6)

TABLE 4.4 • Papules: causal conditions

Type	Cause/Location	Differential Diagnosis
Isolated papules	Tumors	Dermatofibroma, hemangioma, pyogenic granuloma, nevus, BCC, SCC
	Infections	Molluscum contagiosum, wart
	Keratoses	Actinic keratosis, seborrheic keratosis
Papular eruptions	Acneiform	Rosacea, acne vulgaris, perioral dermatitis
	Dermatitis	Atopic dermatitis, contact dermatitis
	Other dermatologic	Psoriasis, lichen planus
	Infections	Folliculitis, molluscum contagiosum, syphilis, viral exanthem, multiple warts, bacillary angiomatosis
	Systemic conditions	Dermatomyositis, SLE, lymphoma, neurofibromatosis, sarcoidosis, urticaria, vasculitis, xanthomas
	Arthropod bites	Scabies, pediculosis
	Drug eruptions	Antibiotics, other drugs
Plaques	Infections	Candidiasis, cellulitis, fungal, tinea, Lyme disease, syphilis
	Systemic conditions	Acanthosis nigricans, neutrophilic dermatoses, granuloma annulare, SLE, lymphoma, scleroderma, myxedema, necrobiosis lipoidica, sarcoidosis, vasculitis
	Other dermatologic	Atopic dermatitis, eczema, ichthyosis, lichen planus, lichen sclerosus, pityriasis rosea, psoriasis, seborrheic dermatitis
Vesicles and bullae	Infections	Congenital syphilis, herpes simplex/zoster, impetigo, staphylococcal scalded skin, varicella
	Immune/allergic/drugs	Dermatitis herpetiformis, atopic dermatitis, contact dermatitis, pemphigus/pemphigoid, SLE, vasculitis, Stevens-Johnson syndrome, toxic epidermal necrolysis, erythema multiforme
	Other	Burns, scabies, bullous arthropod reactions
Pustules	Face	Acne vulgaris, rosacea, perioral dermatitis, tinea barbae, staphylococcal folliculitis, impetigo
	Trunk	Bacterial/fungal infections of sweat glands or follicles, arthropod bites
	With fever	Varicella, syphilis, gonococcus, drugs, pustular psoriasis

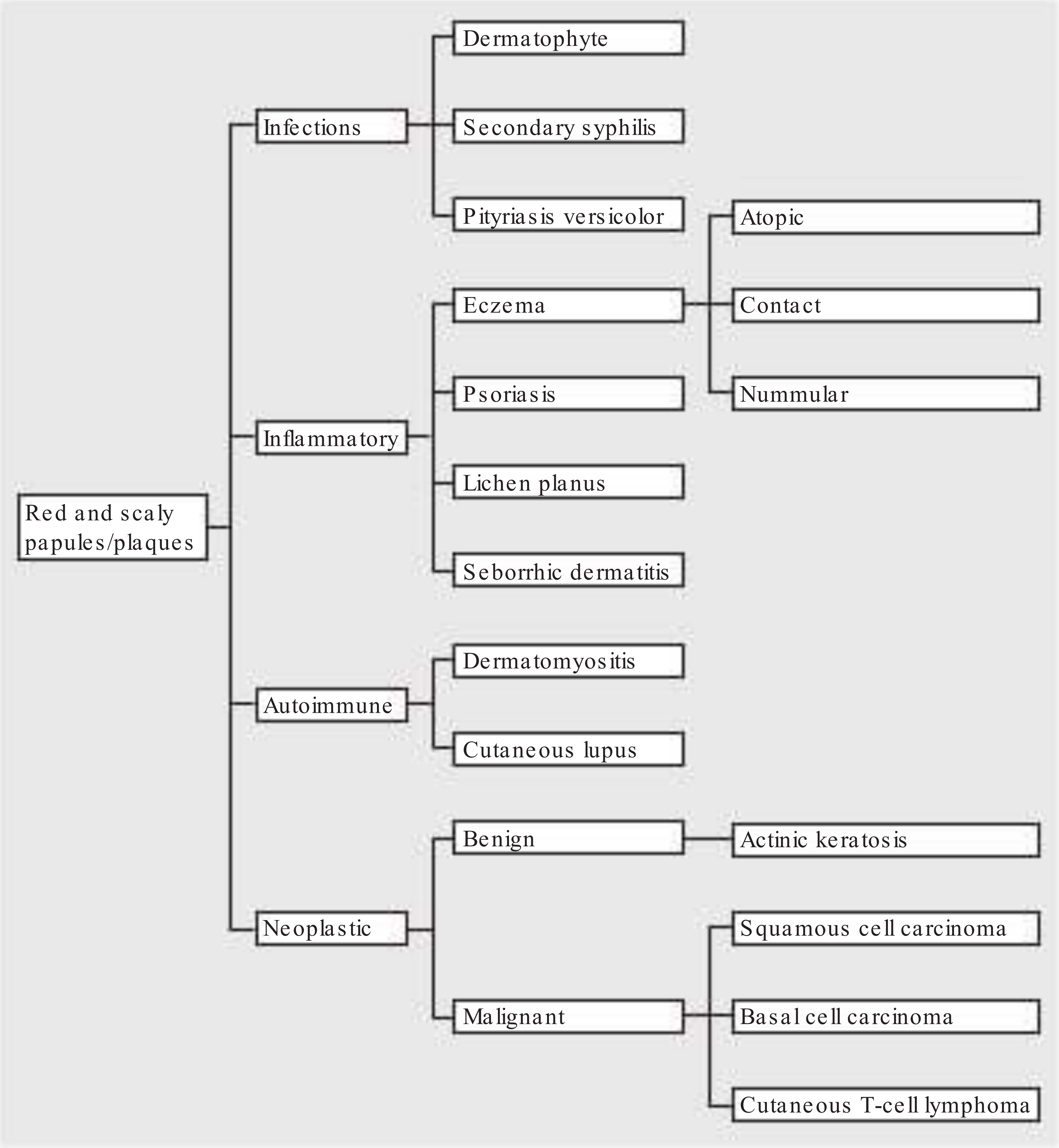

Figure 4.5. Approach to conditions with red and scaly papules/plaques.

Common Childhood Exanthems

- See Table 4.5

Acne Vulgaris

- Abnormal follicular keratinization, increased sebum secondary to androgens, *Propionibacterium acnes* (bacteria), inflammation

Lesions

- Combination of comedones, papules, pustules, and, in severe cases, nodules and cysts (Figure 4.7A)

Diagnosis

- Noninflammatory—open (“black heads”) and closed (“white heads”) comedones
- Inflammatory—papules, pustules, cysts, nodules; deep lesions leave scars

Treatment

- Mild acne
  - Topical antibiotics (clindamycin/erythromycin)
  - Benzoyl peroxide
  - Topical retinoids (tretinoin/adapalene/tazarotene)
  - Salicylic acid
- Moderate acne
  - Addition of oral antibiotics (minocycline/doxycycline/tetracycline)
  - OCP/antiandrogens in females
- Severe acne
  - Oral isotretinoin

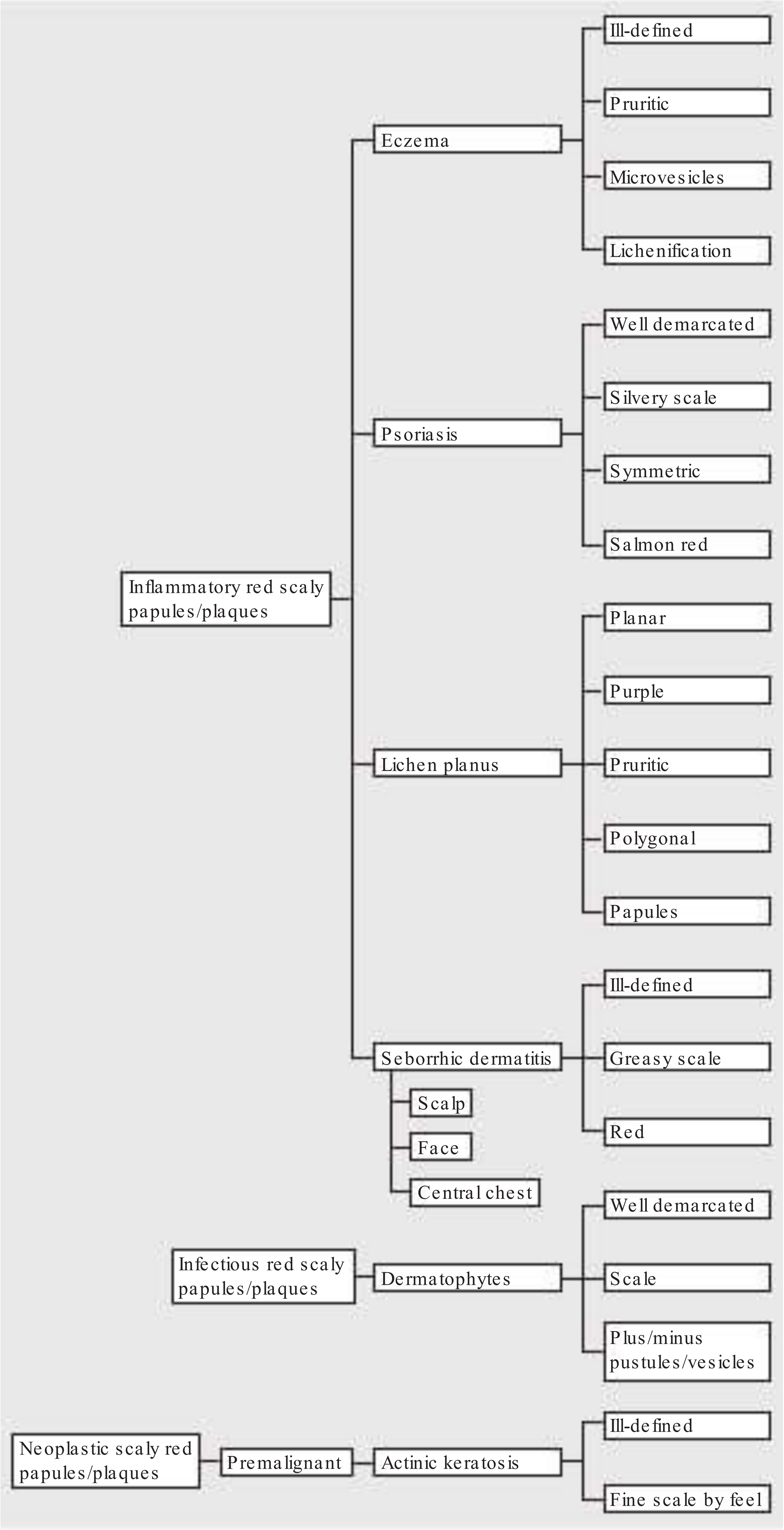

Figure 4.6. Clinical presentation of conditions with red and scaly papules/plaques.

TABLE 4.5 • Approach to common childhood exanthems

Condition	Clinical Presentation
Rubella	Pruritic, red macules and papules
	Begins on the face and spreads to neck, trunk, and extremities; takes 24 h
	Red macules and papules are present on the soft palate (Forchheimer sign)
Measles	Erythematous macules and papules
	Begin on the face and spread cephalocaudally
	Small white spots (Koplik spots) can be present in the oral mucosa
Erythema infectiosum	Bright red cheeks
	Followed by symmetric erythematous eruption on the trunk and extremities
Roseola	Pink macules and papules
	Lesions surrounded by white halos
	Begins on trunk and spreads to neck and proximal extremities

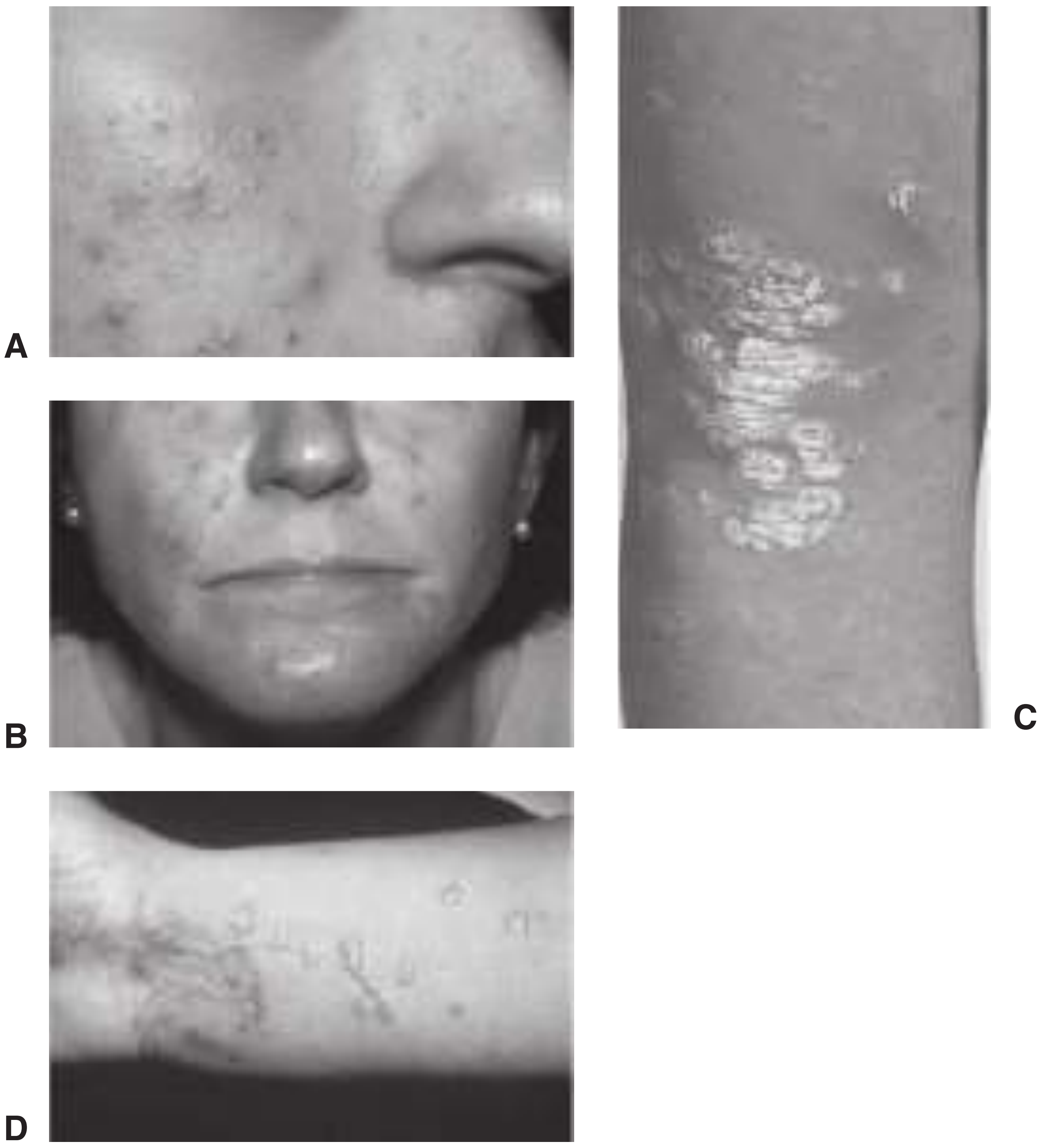

Figure 4.7. Papular skin lesions. Acne vulgaris (A), rosacea (B), psoriasis (C), and lichen planus (D). (Images A, B, and D from Goodheart HP. *Goodheart's Photoguide of Common Skin Disorders: Diagnosis and Management*. 2nd ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2003. Image C reprinted with permission from Bickley LS. *Bates' Guide to Physical Examination and History Taking*. 8th ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2003.)

CLINICAL box

Isotretinoin

Effective contraception is necessary for patients on oral isotretinoin due to its teratogenicity. Patients also need to be warned about the potential for depression and suicidal ideation while on isotretinoin.

Rosacea

- Chronic inflammatory disorder of pilosebaceous units and vasculature of the face
- Sebaceous hyperplasia and seborrheic dermatitis more common

Lesions

- Erythema, telangiectases, papules, and pustules of central face; **no comedones in contrast to acne** (Figure 4.7B)

Variants

- Stage 1—erythema and telangiectases
- Stage 2—papulopustular rosacea; nodules may be present if severe
- Stage 3—hyperplastic and phymatous rosacea (e.g., rhinophyma)—coarse facial features plus soft tissue hyperplasia

Triggers

- Hot beverages
- Spicy foods
- Alcohol
- Sun
- Heat

Treatment

- Topical metronidazole gel or cream
- Oral antibiotics (minocycline/doxycycline/tetracycline)
- Laser for telangiectasia or rhinophyma

CLINICAL box

Rosacea versus Acne

Rosacea can be distinguished from acne by the absence of comedones

Psoriasis

- Chronic, recurrent inflammatory skin condition with abnormal epidermal differentiation and hyperproliferation

Lesions

- Commonly seen on elbows, knees, scalp, nails, intergluteal folds, palms, and soles (see Figure 4.7C)
- Consist of well-demarcated red papules and plaques with classic silvery scale
- Nail changes (pitting, oil drops, onycholysis, subungual hyperkeratosis) also commonly seen
- Psoriasis is associated with psoriatic arthritis in 10% to 30% of cases and may be the first presenting sign of the disease

Treatment

- Body lesions
  - Medium- to high-potency corticosteroid cream or ointment
  - Calcipotriol ointment
  - Tar
  - Anthralin
  - Tazarotene gel or cream
  - Intralesional triamcinolone
  - Phototherapy (UVB, PUVA)
  - Systemic drugs (methotrexate, acitretin, cyclosporine, biologic agents)
- Facial and intertriginous lesions
  - Low-potency corticosteroid cream or ointment
  - Tacrolimus ointment/pimecrolimus cream
- Scalp lesions
  - Tar shampoo
  - Topical corticosteroid lotion/solution/foam
  - Calcipotriol solution
  - Tazarotene gel

CLINICAL box

Clinical Signs of Psoriasis

Koebner phenomenon: physical trauma to the skin causes a psoriasis plaque to form.

Auspitz sign: scale removal results in the appearance of minute droplets of blood. (note that this is not routinely tested.)

Lichen Planus

- Acute or chronic inflammatory disorder affecting the skin, mucous membranes, and nails

Lesions

- Pruritic purple, polygonal, planar (flat-topped) papules and plaques mainly seen on inner wrists, torso, and extremities; overlying **Wickham striae** often seen (see Figure 4.7D)
- White reticulated lesions of mucosal surfaces (lips and buccal mucosa)
- Rule out a drug-induced lichenoid reaction

Treatment
- Can be difficult to treat
- Topical corticosteroids cream
- Systemic agents in widespread cases (acitretin, cyclosporine)

CLINICAL box

Lichen Planus and Hepatitis

Lichen planus has been associated with hepatitis C infection, although infrequently. Therefore, all patients with risk factors should undergo a hepatitis screen.

Perioral dermatitis
- Inflammatory acneiform skin condition
- May be exacerbated by topical steroid abuse

Lesions
- 1 to 2 mm erythematous papulopustules distributed periorally, with sparing of the vermilion border
- Occasional periorbital distribution

Treatment
- Topical metronidazole
- Topical erythromycin
- Systemic antibiotics (minocycline/doxycycline/tetracycline)

SKIN TUMORS/ULCERS

MCC OBJECTIVE

Based on Objective #95 (Skin Tumors and Ulcers) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

A tumor is a skin lesion with significant depth measuring >1 cm.
An ulcer is an excavation extending into the dermis or deeper.

CLINICAL box

Hemangiomas

70% of hemangiomas regress by age 7

CLINICAL box

Dimple Sign

The classic finding of a dermatofibroma. Pinching causes dimpling into the surrounding skin.

CAUSAL CONDITIONS (Figure 4.8)

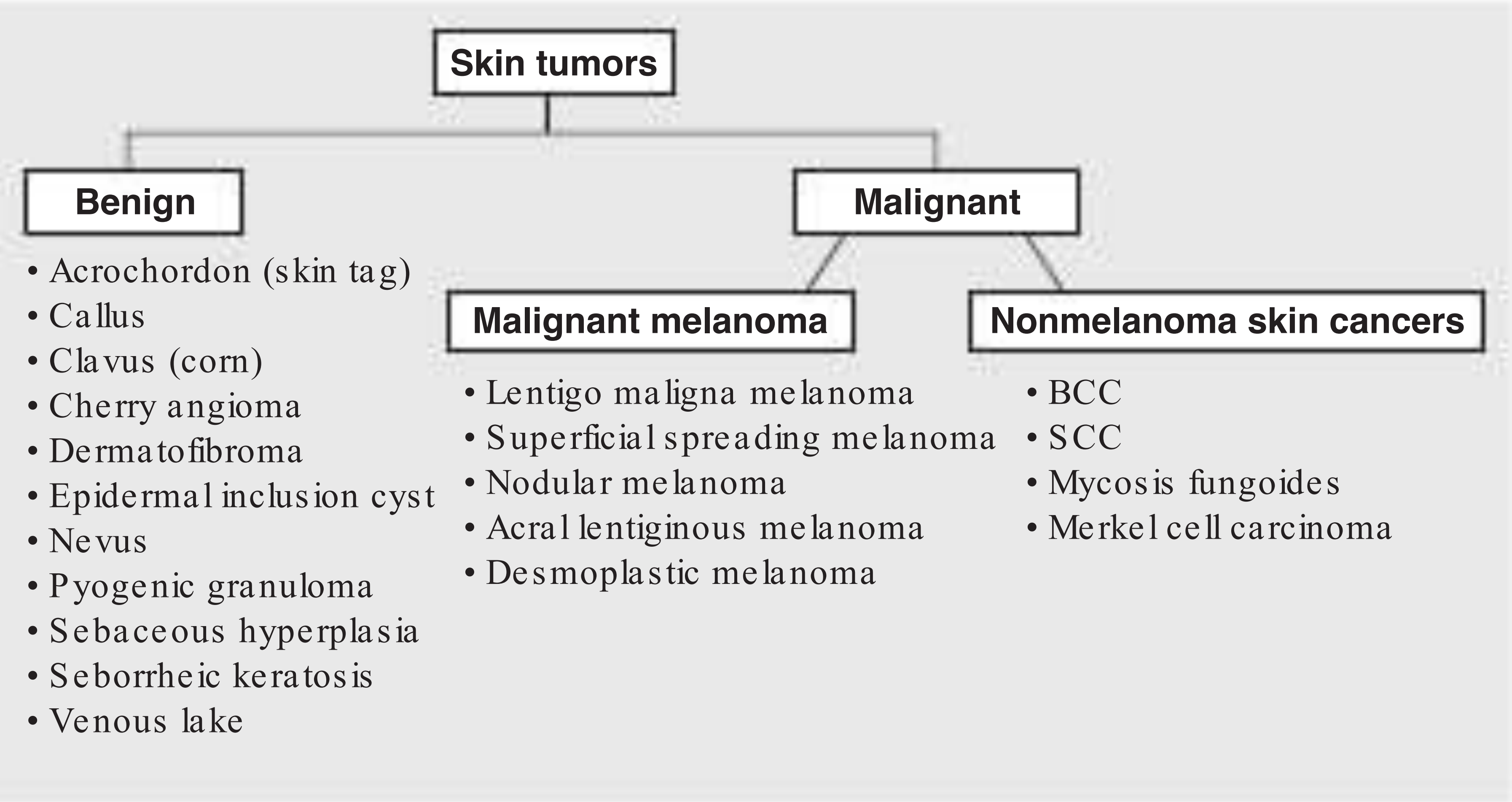

Figure 4.8. Skin tumors: causal conditions.

APPROACH

Benign Skin Tumors

Nevus
- Melanocytic nevi, or moles, are pigmented macules, papules, or nodules arising from the proliferation of melanocytic nevus cells (Figure 4.9)

Subtypes of Melanocytic Nevi
- Junctional nevus
- Compound nevus
- Dermal nevus

- Congenital nevus
- Dysplastic/atypical nevus
- Halo nevus
- Blue nevus

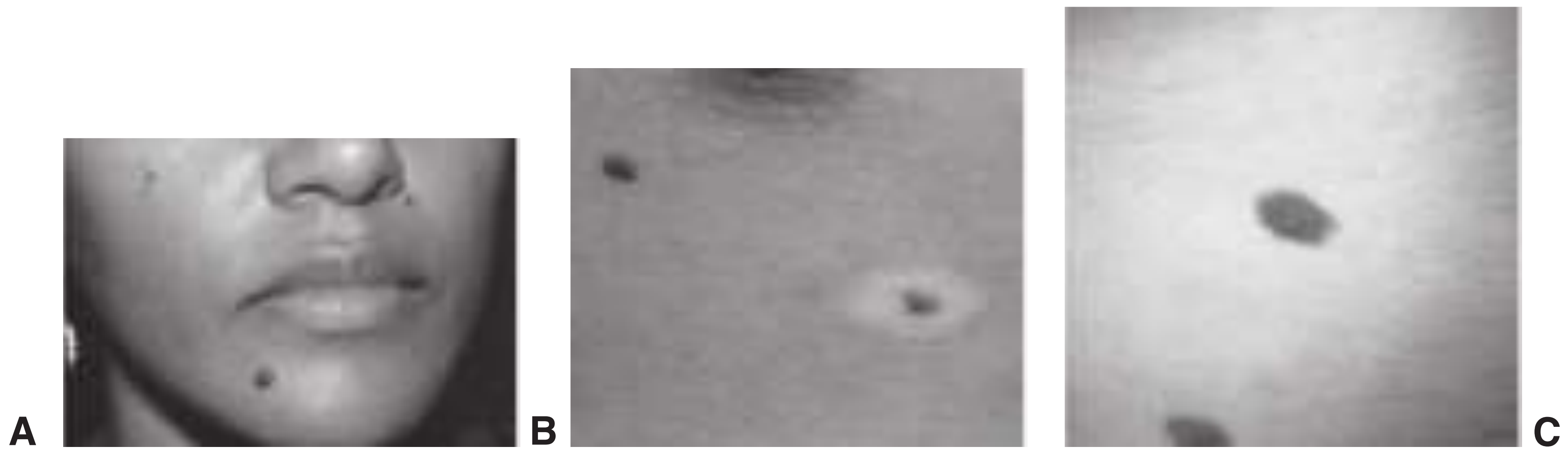

Figure 4.9. Melanocytic nevi. Compound nevus (A), halo nevus (B), and dysplastic/atypical nevus (C). Note the raised center and indistinct border giving a "fried-egg" appearance. (Images from Goodheart HP. *Goodheart's Photoguide of Common Skin Disorders: Diagnosis and Management.* 2nd ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2003.)

Miscellaneous Benign Lesions

Epidermoid Cyst

- Derived from epidermis or the epithelium of the hair follicle
- Formed by cystic enclosure of epithelium within the dermis that becomes filled with keratin and lipid-rich debris
- Dermal-to-subcutaneous nodule connecting with the surface by keratin-filled pores

Milium

- Superficial white-yellow keratin containing epidermal cyst commonly found on the cheeks and eyelids

Digital Myxoid Cyst

- Pseudocyst that presents at the base of the nail of the finger or toe or on the distal interphalangeal joint
- Associated with Heberden node

Seborrheic Keratosis

- Hyperpigmented papules and plaques with a warty surface and a "stuck on" appearance
- Increase in incidence with increase in age

Sebaceous Hyperplasia

- Smooth papules with central umbilication and telangiectasia
- Common in the elderly and those treated with cyclosporine

Lipoma

- Benign, soft, rounded, or lobulated subcutaneous tumors that are easily movable against the overlying skin
- Composed of normal fat cells and commonly found on the neck, trunk, and the extremities

CLINICAL box

Gardner Syndrome

A rare autosomal dominant condition associated with colon cancer in which multiple epidermal inclusion cysts are found and is associated with osteoma, extracolonic, and desmoids tumors

Dermatofibroma

- Common button-like nodule commonly presenting on the extremities
- Often domed, raised, dermal red-brown nodule, but may be depressed
- Can be associated with history of insect bite or ruptured cyst

Hypertrophic Scar and Keloids

- Result from fibrous repair tissues after injury
- Hypertrophic scars are **confined** to the original injury site
- Keloids **extend beyond** the original injury site

Malignant Tumors

Nonmelanoma Skin Cancers and Malignant Melanoma (Table 4.6 and Figure 4.10)

TABLE 4.6 • Nonmelanoma skin cancers versus malignant melanoma

	Nonmelanoma Skin Cancers	Malignant Melanoma
Risk factors	1. UV light exposure (especially UVB) 2. Ionizing radiation exposure (e.g., uranium miners, childhood cancer survivors) 3. Chronic immunosuppression 4. Smoking 5. Phototherapy with psoralens 6. Chronic ulcers/scars 7. Arsenic ingestion 8. Actinic keratoses	1. Skin type I/II (fair skin, red hair, blue eyes) 2. Dysplastic nevus syndrome 3. Congenital nevi 4. Multiple atypical nevi 5. Personal history of melanoma 6. FHx of atypical nevi or melanoma 7. Excessive sun exposure, especially sunburns during childhood, and tanning bed use 8. Immunosuppression 9. Genetic markers (CDKN2A mutation)
Metastases	BCC: extremely rare SCC: 5%–10%	Common
Clinical features	BCC: pearly papule or nodule with peripheral telangiectasias (multiple other presentations also possible) SCC: sharply demarcated scaling or hyperkeratotic papule, plaque, or nodule	**A**symmetry **B**order irregularities **C**olor variegation **D**iameter > 6 mm **E**volution
Treatment	**BCC** Surgical excision Mohs micrographic surgery Electrodessication and curettage Cryotherapy Radiation therapy Topical imiquimod cream Topical 5-fluorouracil cream Photodynamic therapy **SCC** Surgical excision Photodynamic therapy for superficial SCCs (in situ only) Topical imiquimod to treat Bowen disease (SCC in situ) Cryotherapy or imiquimod primarily to treat actinic keratoses (potential precursor to SCC)	Surgical excision • in situ: 0.5 cm margins • < 2 mm thick: 1 cm margins • ≥ 2 mm thick: 2 cm margins ± lymph node dissection, adjuvant treatment with chemotherapy (e.g., interferon a-2b)
Prevention	Sun avoidance and sun protection Avoidance or protection from carcinogenic chemicals (e.g., arsenic) Regular skin self-examination	Sun avoidance and sun protection Screening in patients with FHx, dysplastic, and multiple nevi Regular skin self-examination

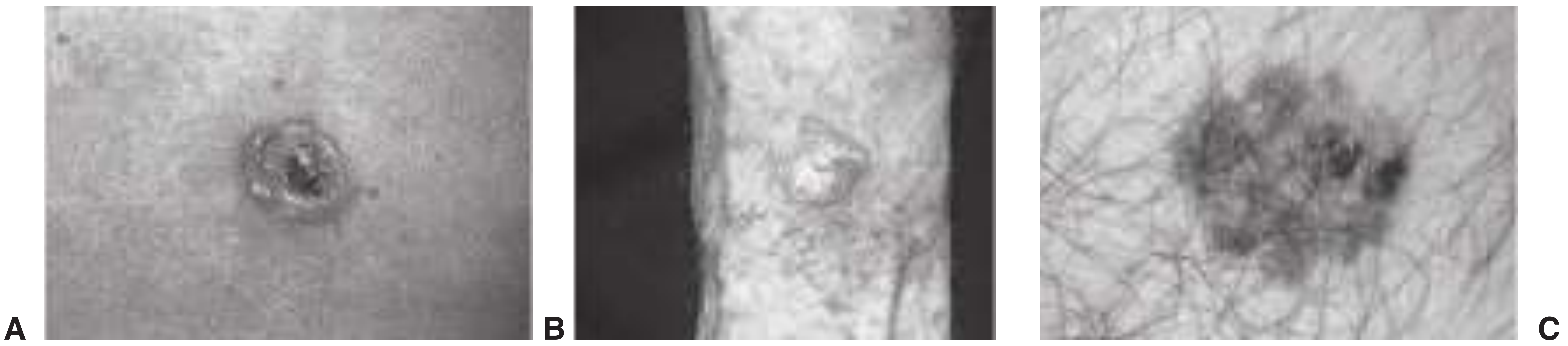

Figure 4.10. Malignant tumors: nodular BCC (A). Note the pearly rolled border characteristic of BCC, SCC (B), and superficial spreading melanoma (C). (Images from Goodheart HP. *Goodheart's Photoguide of Common Skin Disorders: Diagnosis and Management*. 2nd ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2003.)

Mycosis Fungoides

- The most common clinicopathologic subtype of primary **cutaneous T-cell lymphoma**

Lesions

- Mycosis fungoides often presents as thin scaly red plaques in "bathing suit" distribution

- Can present or progress to plaques, nodules, tumors
- Mycosis fungoides with extensive infiltration can cause **leonine facies**

Treatment

- Topical corticosteroids
- Nitrogen mustard
- Narrow-band UVB or PUVA
- Total body electron beam therapy

CLINICAL box

Side Effects of Interferon α-2b

Myelosuppression

Liver toxicity

Thyroid dysfunction

SKIN RASH, VESICLES/BULLAE

MCC OBJECTIVE

Based on Objective #97 (Skin Rash/Papules) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Vesicles are elevated lesions (< 1 cm) containing serous fluid.
Bullae are elevated lesions (> 1 cm) containing serous fluid.

CAUSAL CONDITIONS

See Table 4.4.

APPROACH

Bullous Pemphigoid

- Autoimmune bullous skin disease affecting middle-aged or elderly patient
- It can be associated with pruritus

Lesions

- Widespread blistering eruption on erythematous or normal skin base
- Erosions may be present after vesicles/bullae burst
- Flexural areas, groin, and axillae are commonly involved
- Oral lesions less commonly involved

Treatment

- Topical strong steroids for localized disease
- Can use oral prednisone/steroid-sparing agents (e.g., methotrexate azathioprine, mycophenolate mophetil)

Pemphigus Vulgaris

- Serious autoimmune blistering disease affecting patients 50 to 60 yr of age
- Painful skin lesions and/or oral mucosae
- Pruritus is uncommon

Lesions

- Flaccid blisters or epidermal bulla, or residual erosions
- Mouth ulcers are common and are often the initial presentation
- Hyperpigmented patches can be seen after lesions have healed
- Nonscarring

Treatment

- Hospital admission to the burn unit may be required
- Prednisone high dose initially followed by steroid-sparing agents started early disease while tapering prednisone: azathioprine, mycophenolate mofetil, methotrexate, cyclophosphamide, IVIG
- Antibiotics if secondarily infected

CLINICAL box

Useful Signs in Diagnosis of Conditions Involving Epidermal Necrolysis

Nikolsky sign: rubbing the skin causes separation of epidermis and formation of a new blister.

Asboe-Hanson sign: rubbing the lesion in the lateral direction causes it to extend.

Herpes Simplex

HSV-1

- Common viral infection associated with oral-facial lesions on the vermilion border

HSV-2

- Common viral infection mostly affecting the genital mucosa. Less commonly oral mucocutaneous areas can be affected
- Presents as subclinical primary episode or several days of fever, malaise, lymphadenopathy, oral mucosal erosions
- May be reactivated by stress, fever, UV light, trauma

Other Forms
- Herpetic whitlow: herpes of fingertip
- Eczema herpeticum: eczema secondarily infected with herpes

Lesions
- Grouped umbilicated vesicles on erythematous base. Burning and itching may be preceding.

Diagnosis
- Tzanck smear shows multinucleate giant epithelial cells
- Viral culture or PCR from lesion swab
- Antibody testing of fluid from base of vesicle

Treatment
- Often supportive; can treat if severe or disseminated
- Oral antiviral therapy may reduce pain, viral shedding, and healing time if initiated within 72 hours
- Topical antivirals of no benefit

Herpes Zoster (Shingles)

- Primary infection with VZV causes chickenpox
- Reactivation results in herpes zoster (shingles) and may be triggered with immunosuppression or stress
- It may result in postherpetic neuralgia

Lesions
- Clusters of erythematous papules and vesicles commonly following pain in a unilateral dermatomal distribution
- The lesions eventually become crusted and desquamate

Treatment
- Often supportive; can treat if severe or disseminated
- Oral antiviral therapy may reduce pain, viral shedding, and healing time if initiated within 72 hours
- Topical antivirals of no benefit

Stevens-Johnson Syndrome/Toxic Epidermal Necrolysis

- Acute life-threatening mucocutaneous disorders with extensive necrosis and detachment of the epidermis
- Drugs are most important etiologic factor (carbamazepine, phenytoin, allopurinol, lamotrigine, NSAIDs, sulfa drugs)
- Life threatening because of multisystem involvement

Lesions
- Purpuric and erythematous macules develop into flaccid blisters involving the trunk, upper limbs, and mucous membranes (buccal, genital, and ocular mucosa)
- Positive Nikolsky sign

Treatment
- It is most essential to identify and remove the culprit drug
- Supportive care, including burn unit or ICU admission, and ophthalmology assessment
- Antibiotics if any evidence of infection
- IVIG therapy is becoming more commonly used, but it is controversial

CLINICAL box

Classification based on the total Area of Detached/Detachable Epidermis

SJS: less than 10% BSA

SJS/TEN overlap: between 10% and 30% BSA

TEN: more than 30% BSA

PRURITUS

MCC OBJECTIVE

Based on Objective #85 (Pruritus) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Pruritus is characterized by the sensation provoking a desire to scratch. It is the most common symptom in dermatology and can be associated with primary skin disease or underlying systemic disorder.

CAUSAL CONDITIONS (Table 4.7)

Atopic Dermatitis

A hypersensitivity reaction characterized by severe pruritus and dry skin; associated with a personal or FHx of atopy (asthma, eczema, hay fever).

CLINICAL box

Type 1 Hypersensitivity

Urticaria is a type 1 (IgE-mediated) hypersensitivity reaction

TABLE 4.7 • Pruritus: causal conditions

With Skin Lesions	
Primary skin disease	Atopic dermatitis Dermatitis herpetiformis Bullous pemphigoid Psoriasis Lichen planus Mastocytosis
Parasitosis	Scabies Pediculosis
Allergy	Allergic contact dermatitis Urticaria
Bites	Insect Fleas Bed bugs
Psychiatric	Neurotic excoriations
Without Skin Lesions	
Drugs/food	Opioids Cocaine
Obstructive biliary disease	PBC Cholestasis of pregnancy Cholestasis from drugs
Hematologic	Polycythemia vera Lymphoma
Uremia	Renal failure
Malignancy	Adenocarcinomas Gastric carcinoids
Endocrine	Thyrotoxicosis Hypothyroidism Diabetes mellitus
Other	Xerosis (e.g., winter itch)

Aggravating Factors

- Inhalants (dust mites/pollens)
- Winter
- Wool clothing
- Emotional stress
- Excessive hand washing
- Foods (controversial)

Lesions

- Erythematous patches/papules/plaques
- Associated scales, crusts, and excoriations from scratching or secondary infections
- Lichenification (thickening with accentuated skin markings)
- Fissures and Dennie-Morgan folds (infraorbital eyelid fold)

Stages

- Infantile stage: extensor surfaces, face, scalp
- Childhood stage: flexural surface, lichenification present
- Adult stage: hand eczema and xerosis

Obstructive Biliary Disease

Common Causes

- PBC

- Renal disease
- Cholestasis of pregnancy
- Cholestasis from drugs

Lesions

- Excoriations from scratching; commonly start on the palms and the soles and then become generalized
- Jaundice

Treatments

- Bile acid resins (cholestyramine, colestipol)
- Opioid antagonists (naloxone)

CLINICAL box

Pruritus and PbC

Pruritus is the presenting symptom in 50% of patients with PBC

Endocrine disorders

Thyrotoxicosis

- Intractable itching in 4% to 11% of patients; believed to be due to increased blood flow

Hypothyroidism

- Pruritus caused by xerosis

Diabetes Mellitus

- Pruritus caused by anhidrosis from diabetic neuropathy/autonomic dysfunction
- Pruritus vulvae/ani secondary to candidiasis, dermatophyte, and bacterial or parasitic infections

CLINICAL box

Gastric Carcinoids

Gastric carcinoids can be associated with a histamine flush causing pruritus

APPROACH

History

- Identify underlying dermatosis or systemic disease

Investigations

For generalized pruritus without primary skin lesions:

- CBC and differential
- LFTs: bilirubin, transaminases, and alkaline phosphatase
- Renal function tests: BUN, creatinine, urinalysis
- Thyroid function test: TSH
- Fasting blood glucose
- Stool and serology for parasites
- Others: chest x-ray

Management

- Avoid scratching to break the itch–scratch cycle
- Avoid using excessively hot water for showers/baths
- Use appropriate topical ± systemic ± other therapies
- Treat underlying disorder

Therapies for Pruritus (Figure 4.11)

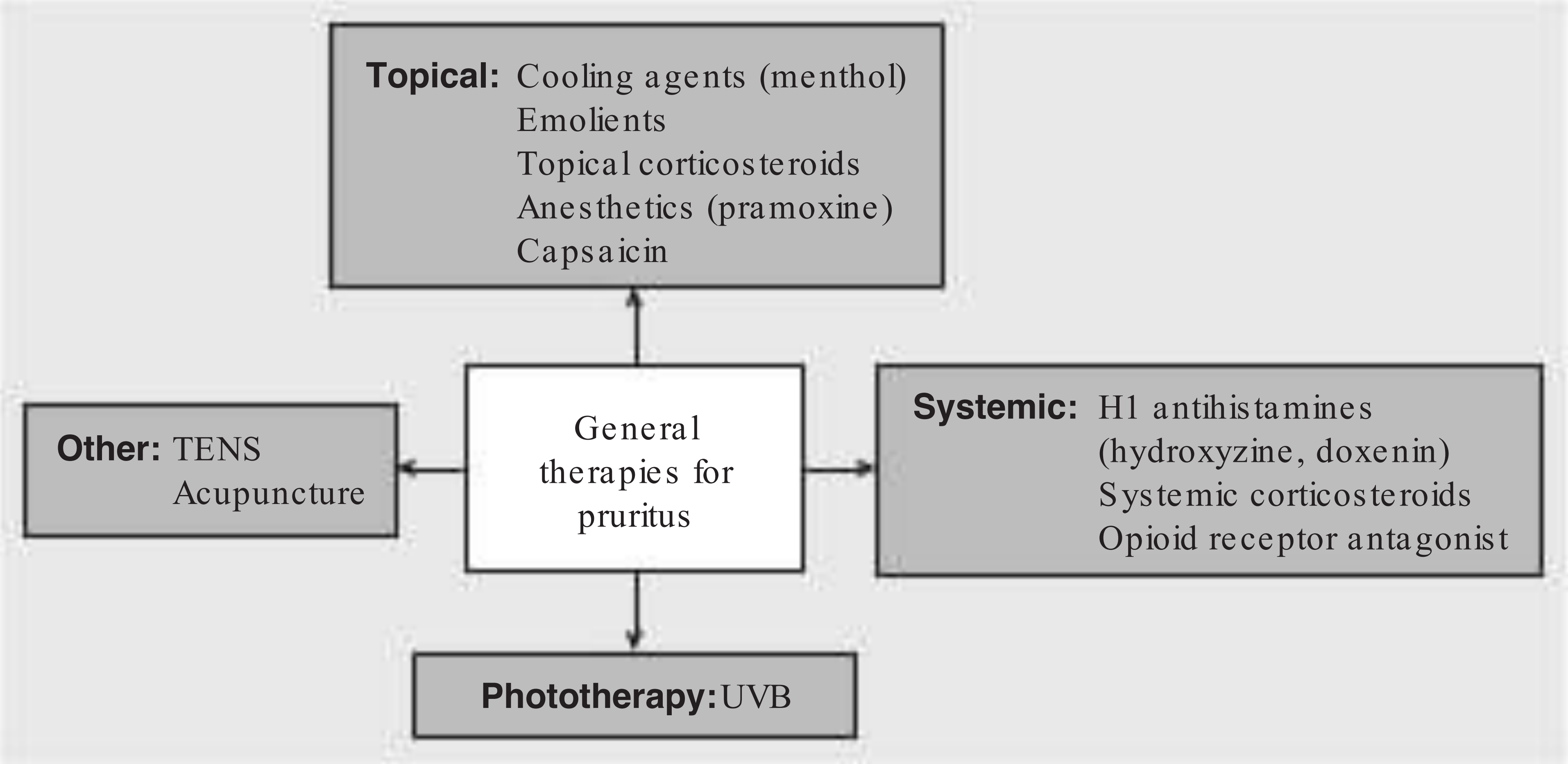

Figure 4.11. Therapies for pruritus.

HAIR DISORDERS

MCC Objective

Based on Objective #38-1 (Alopecia) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Alopecia refers to hair loss, while cicatricial alopecia is hair loss that is associated with fibrosis and scar tissue (scarring alopecia).

CLINICAL box

Hair Changes

Hair changes can provide clues to an underlying disease process

CAUSAL CONDITIONS (Table 4.8)

TABLE 4.8 • Alopecia: causal conditions

Cicatricial Alopecia	
Infection	Severe folliculitis
	Dissecting cellulitis
Skin conditions	Bullous diseases
	Lichen planopilaris
	Discoid lupus erythematosus
Chemical alopecia	Hair dyes
	Hair relaxers
Tumors	Primary tumor of the scalp
	Metastatic tumor to the scalp
Noncicatricial Alopecia	
Infection	Tinea capitis
	Secondary syphilis
Autoimmune conditions	Alopecia areata
	Alopecia totalis
	Alopecia universalis
Stressors	Telogen effluvium
	Anagen effluvium
	Traumatic alopecia
	Trichotillomania
Hormonal/genetic	Androgenetic alopecia

CLINICAL box

Depigmentation

Depigmentation of the hair shaft can be caused by protein or copper deficiency

CLINICAL box

Androgenetic Alopecia

Most common cause of noncicatricial alopecia in both men and women

APPROACH

Investigations

Baseline
- CBC
- Ferritin
- TSH
- Microscopic examinations and fungal culture, if fungus suspected

Other
- Scalp biopsy
- ANA
- Androgens

Management

Androgenetic Alopecia (Pattern Hair Loss)

Cause

- The action of androgens on scalp hair follicles and genetic predisposition

Treatment

- Topical minoxidil (men and women)
- Oral finasteride (men only)
- Hairpieces
- Hair transplantation

Telogen Effluvium

Cause

- Increased daily hair loss triggered by any physical or mental stressor to the body (e.g., illness, childbirth, medications)

Treatment

- Full regrowth expected with no treatment

Alopecia Areata

Cause

- An autoimmune disease causing localized round or oval patches of hair loss
- Alopecia totalis = when all scalp hair is lost
- Alopecia universalis is when all body hair is lost

Treatment

- Steroids (topical/intralesional/systemic)
- Minoxidil
- Topical anthralin
- Topical contact sensitizers

CLINICAL box

Exclamation Point Hairs

Short, broken-off hairs, known as exclamation point hairs, are a hallmark feature of alopecia areata

CLINICAL box

Subungual Hematoma versus Melanoma

Always biopsy when melanoma is suspected

NAIL DISORDERS

MCC OBJECTIVE

Based on Objective #38-2 (Nail Complaints) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Onycholysis is the separation of the nail plate from the nail bed, onychogryphosis is the severe thickening of the nail plate with deformed shape, and onychomycosis is a chronic fungal infection where the nail plate becomes yellowed, thickened, and dystrophic.

CAUSAL CONDITIONS (Table 4.9)

APPROACH

Paronychia

- Red, painful lesion around the nail fold (Figure 4.12A)

Cause

- Most commonly a *S. aureus* infection if acute; when seen in thumb suckers/nail biters/nail pickers and those who do a lot of "wet" work, it is generally chronic and associated with *C. albicans*

Treatment

- Topical glucocorticoids
- Minimize irritants and water exposure
- Treat the secondary infection with topical antibacterials or antifungals

Herpetic Whitlow

- Painful grouped vesicles on an erythematous base located on the distal finger (Figure 4.12B)

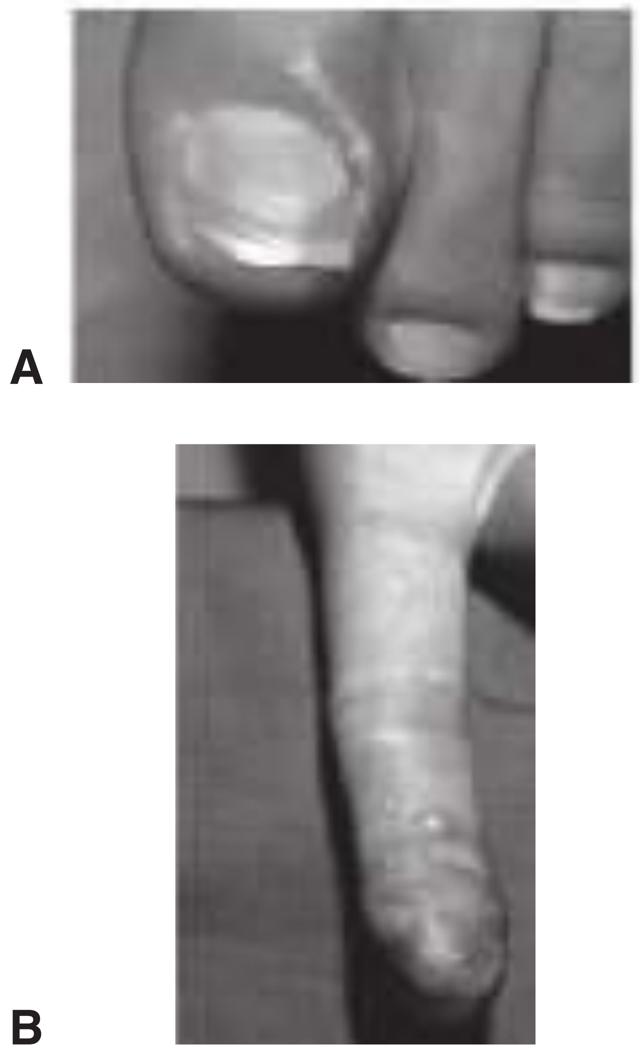

Figure 4.12. Local nail problems. Acute paronychia (A) and herpetic whitlow (B).

(From Goodheart HP. *Goodheart's Photoguide of Common Skin Disorders: Diagnosis and Management*. 2nd ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2003.)

CLINICAL box

Herpetic Whitlow

Commonly seen in health-care professionals before the institution of universal precautions

Cause

Infection with HSV

Treatment

- Self-limiting disease
- Antiviral (e.g., acyclovir) may be beneficial

TABLE 4.9 • Causal conditions of nail disorders

<table>
<tr><th colspan="5">Shape Change</th></tr>
<tr><th colspan="3">Description</th><th colspan="2">Causal Conditions</th></tr>
<tr><td colspan="3">Hourglass nail/finger clubbing</td><td colspan="2">CVD
Lung disease
GI disorders
Chronic methemoglobinemia</td></tr>
<tr><td colspan="3">Hollow/spoon-shaped/koilonychia</td><td colspan="2">Iron deficiency
Malnutrition
Diabetes
Old age</td></tr>
<tr><td colspan="3">Hypoplastic</td><td colspan="2">Fetal alcohol syndrome
Nail-patella syndrome</td></tr>
<tr><td colspan="3">Onycholysis</td><td colspan="2">Psoriasis
Thyroid disease
Trauma
Fungal infections</td></tr>
<tr><td colspan="3">Onychogryphosis</td><td colspan="2">Chronic inflammation
Tinea
Psoriasis</td></tr>
<tr><td colspan="3">Onychomycosis</td><td colspan="2">Fungal infection often caused by T. rubrum or T. mentagrophytes</td></tr>
<tr><th colspan="5">Surface Change</th></tr>
<tr><td colspan="3">Transverse grooves/Beau lines</td><td colspan="2">Significant acute systemic disease</td></tr>
<tr><td colspan="3">Transverse white lines/transverse leukonychia</td><td colspan="2">Hypoalbuminemia
Chemotherapeutic agents
Poisons</td></tr>
<tr><td colspan="3">Pitting</td><td colspan="2">Psoriasis
Alopecia areata
Eczema
Paronychia
Inflammatory damage</td></tr>
<tr><th colspan="5">Color Change</th></tr>
<tr><th>Yellow</th><th>Black</th><th>Brown</th><th>Splinter Hemorrhages</th><th>Blue-Green</th></tr>
<tr><td>1. Tinea
2. Jaundice
3. Tetracycline
4. Hypoplasia/dysplasia of lymphatics</td><td>1. Hematoma
2. Melanoma</td><td>1. Nicotine
2. Psoriasis
3. Poisons (e.g., excessive fluoride ingestion)
4. Melanonychia striata
5. Melanoma</td><td>1. Trauma (most common)
2. Bacterial endocarditis
3. Blood dyscrasias</td><td>1. Pseudomonas
2. Drug-induced (e.g., AZT)</td></tr>
</table>

Onychocryptosis/Ingrown Nails

- Inflammation and soft tissue hypertrophy ± secondary infection occurring when the lateral edge of the nail plate impinges on the nail fold

Cause

- Onychomycosis
- Incorrect technique of nail cutting

- Repetitive trauma
- Poor foot hygiene; poorly fitting shoes

Treatment
- Barrier placement between nail plate and nail fold
- Excision of the portion of nail plate pressing on the nail fold
- ± Antibiotics

DERMATOLOGIC EMERGENCIES

MCC OBJECTIVE

No specific objective. Based on above objectives from the *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Candidates should be aware of dermatologic presentations that warrant urgent examination.

CLINICAL box

Concerning Dermatologic Presentations

Generalized red rash with any of fever, vesicles, mouth lesions, purpura, or generalized scaling is concerning and should be promptly investigated.

CAUSAL CONDITIONS

Vesiculobullous Disorders

- Stevens-Johnson syndrome/toxic epidermal necrolysis
- Pemphigus vulgaris
- Bullous pemphigoid

Infections

- Hemorrhagic fevers
- Leprosy (reversal reaction upon treatment) mucormycosis
- Necrotizing fasciitis
- Neonatal herpes simplex
- RMSF
- Still disease, trichinosis, tularaemia

Autoimmune Disorders

- Systemic and neonatal lupus erythematosus
- Dermatomyositis

Inflammatory Cutaneous Disorders

- Acne fulminans
- Acute drug eruptions
- Acute pustular psoriasis
- Exfoliative erythroderma
- Kawasaki syndrome
- Pyoderma gangrenosum
- Scarring alopecias

SKIN CHANGES IN SYSTEMIC DISEASE

MCC OBJECTIVE

No specific objective. Based on above objectives from the *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Candidates should be aware of the dermatologic presentation of general medical conditions.

CAUSAL CONDITIONS

- **Liver disease:** gynecomastia, jaundice, caput medusa, loss of body hair, palmar erythema, peripheral edema, purpura, spider angiomas

- **Renal failure:** photodistributed or diffuse hyperpigmentation (including palms and soles) pallor, yellow tinge
- **Diabetes:** acanthosis nigricans, foot ulcers, pruritus, light brown slightly indented scaly patches (diabetic dermopathy), yellow skin, and nails
- **Pyoderma gangrenosum:** ulcerative colitis, Crohn disease, rheumatoid arthritis
- **Cushing syndrome:** acanthosis nigricans, acne, buffalo hump, hirsutism, telangiectasia, striae, atrophic skin
- **Neurofibromatosis:** café au lait macules, freckling, multiple cutaneous neurofibromas
- **Porphyria:** blister formation, photosensitivity, hypertrichosis, pigmentation, skin fragility
- **Hyperlipidemia:** xanthomas

CHAPTER 5

Emergency Medicine

William Sevcik • Katherine E. Smith • Adam Thomas

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Facial Injuries
Hyperthermia
Hypothermia
Poisoning
Skin Wounds and Regional Anesthesia
Submersion Injuries
Trauma

ALLERGIES, URTICARIA, AND ANAPHYLAXIS

MCC OBJECTIVE

Based on Objective #97-2 (Urticaria, Angioedema) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Anaphylaxis is rapidly progressive, potentially life-threatening reaction that requires rapid clinical recognition and possibly aggressive airway and cardiovascular support.
- Angioedema coexists in half of pts with urticaria and can be potentially life threatening.

APPLIED SCIENTIFIC CONCEPT

- **Allergic reactions** occur on a spectrum from local dermatologic manifestations to systemic presentations and anaphylactic shock.
- **Anaphylaxis:** IgE-mediated, immediate onset reactions to a protein antigen. A prior *sensitizing* exposure to the antigen is required (Figure 5.1).
- **Anaphylactoid reactions** occur on initial exposure to antigen. They are clinically identical to anaphylaxis but are not IgE-mediated.
- **Biphasic anaphylaxis:** recurrence of symptoms 4 to 32 h (mean 10 h) after initial episode. It occurs in approximately 20% of pts and is due to release of 2° mediators, causing late-phase response.
- **Protracted anaphylaxis:** refractory Resp distress or hypotension despite appropriate medical Rx.
- **Acute urticaria:** Recurrence lasts < 6 wks.
- **Chronic urticaria:** Recurrence lasts > 6 wks.

ASC box

Cytokines Contributing to Late-phase Anaphylactic Response

IL-4—↑ IgE secretion

IL-5—recruitment and activation of leukocytes

TNF-a—anaphylactic shock via loosening of endothelial junctions, ↓ peripheral vascular resistance, and ↓ cardiac contractility

ASC box

Types of Hypersensitivity Reactions

Type I: immediate hypersensitivity → IgE mediated, for example, urticaria

Type II: cytotoxic reactions → IgG and IgM mediated, for example, Goodpasture syndrome

Type III: immune complex reactions → soluble immune complexes and complement mediated, for example, serum sickness

Type IV: delayed-type reaction → lymphocyte mediated, for example, contact sensitivity

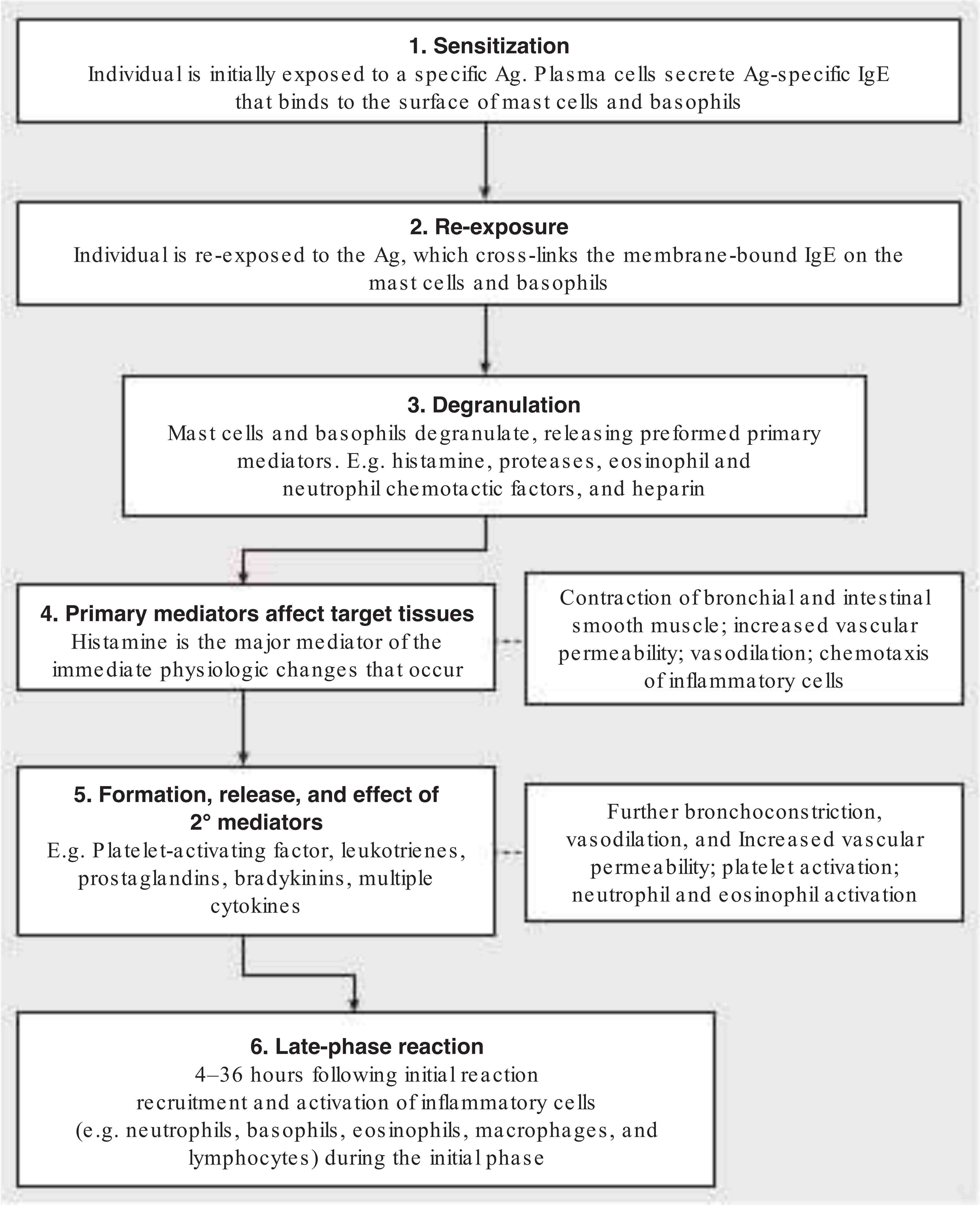

1. Sensitization
Individual is initially exposed to a specific Ag. Plasma cells secrete Ag-specific IgE that binds to the surface of mast cells and basophils
2. Re-exposure
Individual is re-exposed to the Ag, which cross-links the membrane-bound IgE on the mast cells and basophils
3. Degranulation
Mast cells and basophils degranulate, releasing preformed primary mediators. E.g. histamine, proteases, eosinophil and neutrophil chemotactic factors, and heparin
4. Primary mediators affect target tissues
Histamine is the major mediator of the immediate physiologic changes that occur
Contraction of bronchial and intestinal smooth muscle; increased vascular permeability; vasodilation; chemotaxis of inflammatory cells
5. Formation, release, and effect of 2° mediators
E.g. Platelet-activating factor, leukotrienes, prostaglandins, bradykinins, multiple cytokines
Further bronchoconstriction, vasodilation, and Increased vascular permeability; platelet activation; neutrophil and eosinophil activation
6. Late-phase reaction
4–36 hours following initial reaction recruitment and activation of inflammatory cells (e.g. neutrophils, basophils, eosinophils, macrophages, and lymphocytes) during the initial phase

Figure 5.1. Anaphylaxis: cellular mechanisms, immune mediators, and physiologic Δs.

Causal Conditions (Tables 5.1 and 5.2)

table 5.1 • Common causes of anaphylaxis

Foods	Peanuts/nuts, seafood, eggs, cow's milk
Hymenoptera	Bees, wasps, fire ants
Drugs	b-lactam Abx, NSAIDs, ACEIs, vaccines, local anesthetics, antineoplastic meds
Human products	Blood products, insulin
Iatrogenic	Latex, radiocontrast material

table 5.2 • Common causes of urticaria

IgE mediated	Same as anaphylaxis triggers above
Direct mast cell release	Opiates, muscle relaxants, radiocontrast materials
Complement mediated	Serum sickness, transfusion Rxns, infections, vasculitis
Arachidonic acid metabolism	ASA, NSAIDs
Physical	Cold, dermatographism, cholinergic, sun exposure, pressure
Other	Mastocytosis

APPROACH

The Basics

- Pts may initially present with mild symptoms, but can deteriorate quickly.
- There are no tests of diagnostic value in the immediate setting of anaphylaxis *or* urticaria. Both are clinical diagnoses and do not usually produce initially abnormal lab results.

Hx

- Known exposure of a possible antigen, known allergies/family Hx of allergies, and/or presence of atopy
- Previous allergic reactions/anaphylaxis

Physical Exam

- **CNS:** anxiety, headache, ↓ level of consciousness
- **Resp:** oropharyngeal swelling, chest tightness, dyspnea, wheeze, stridor, hypoxia → eventual Resp arrest
- **CVS:** hypotension, tachycardia, palpitations, weak pulses → eventual cardiac arrest
- **GI:** dysphagia, abdominal pain and cramping, nausea, vomiting, diarrhea
- **Derm:** pruritus, urticaria, angioedema

Management (Figure 5.2)

Disposition

- All pts should be observed for 6 to 8 h.
- Discharge teaching (see Clinical Box, SAFE Discharge Instructions) around signs of delayed-phase anaphylaxis and avoidance of repeat exposure.
- *All* pts should be discharged with a prescription for two EPI auto injectors and should be advised to follow up with primary care provider.
- Outpatient allergy testing can be arranged, but do *not* wait for testing to provide prescriptions.

CLINICAL box

What Saves Lives? EPI, EPI, EPI

Adults: 0.3 to 0.5 mg IM

Kids: 0.01 mg/kg IM (max dose 0.3 mg)

If No Response

Repeat dose in 5 to 15 min × 1

If No Response and the Patient is Extremis → Epi Drip

0.1 mL of 1:1,000 EPI diluted in 10 cc NS administered 1 to 2 cc/min IV

CLINICAL box

SAFE Discharge Instructions

Support: someone to monitor pt at home

Allergen: identify and avoid precipitating agent

Follow-up: outpatient allergy testing

EPI injector: prescription for 2 doses

Adapted from Tupper J, Visser S. Anaphylaxis: a review and update. Can Fam Physician. 2010;56(10):1009–1011.

FOR MORE INFORMATION

- Can direct pts to: www.anaphylaxis.ca
  - An editorial review of the state of the evidence in anaphylaxis management: Estelle F, Simons R. Emergency treatment of anaphylaxis. *BMJ.* 2008;336(7654):1141–1142.
- A more detailed discussion of pediatric anaphylaxis in the emergency department: Santillanes G, Davidson J. An evidence-based review of pediatric anaphylaxis. *Pediatr Emerg Med Pract.* 2010;7(10):1–20.

BITES: HUMAN, ANIMAL, AND INSECT

MCC OBJECTIVE

Based on Objective #109-2 (Insect Stings and Bites) of *Objectives for the Qualifying Examination,* 3rd edition.

OVERVIEW

- Irrigate, irrigate, irrigate—same basic principles of wound care apply
- Administer tetanus, rabies vaccine, and prophylactic Abx as appropriate
- Always check for tooth fragments and other foreign bodies in wounds

CAUSAL CONDITIONS

- 1% of total ED visits, animal bites more common in children
- Human bites
  - “Fight bites”—puncture wounds on assailant after punching someone in the mouth. Be sure to check for foreign bodies (*tooth fragments*)
  - Always remember to examine hand in position that it was when injury occurred as that can help identify subtle injuries that would otherwise be missed.
- Dog bites
  - Can cause significant bleeding and scarring

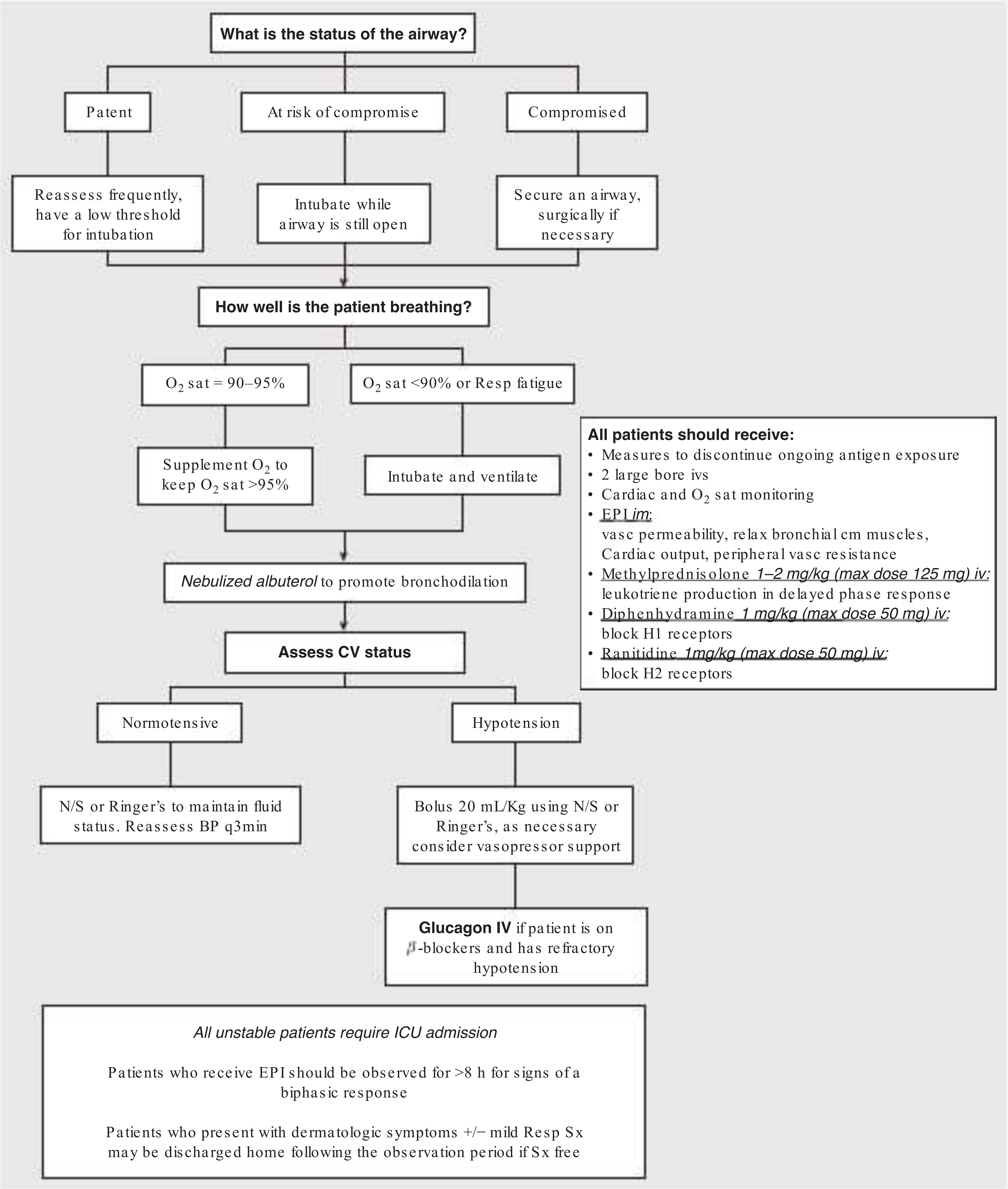

What is the status of the airway?
Patent
At risk of compromise
Compromised
Reassess frequently, have a low threshold for intubation
Intubate while airway is still open
Secure an airway, surgically if necessary
How well is the patient breathing?
O2 sat = 90–95%
O2 sat <90% or Resp fatigue
Supplement O2 to keep O2 sat >95%
Intubate and ventilate
Nebulized albuterol to promote bronchodilation
Assess CV status
Normotensive
Hypotension
N/S or Ringer's to maintain fluid status. Reassess BP q3min
Bolus 20 mL/Kg using N/S or Ringer's, as necessary consider vasopressor support
Glucagon IV if patient is on β-blockers and has refractory hypotension
All patients should receive:
• Measures to discontinue ongoing antigen exposure
• 2 large bore ivs
• Cardiac and O2 sat monitoring
• EPI im:
vasc permeability, relax bronchial cm muscles,
Cardiac output, peripheral vasc resistance
• Methylprednisolone 1–2 mg/kg (max dose 125 mg) iv:
leukotriene production in delayed phase response
• Diphenhydramine 1 mg/kg (max dose 50 mg) iv:
block H1 receptors
• Ranitidine 1mg/kg (max dose 50 mg) iv:
block H2 receptors
All unstable patients require ICU admission
Patients who receive EPI should be observed for >8 h for signs of a biphasic response
Patients who present with dermatologic symptoms +/− mild Resp Sx may be discharged home following the observation period if Sx free

Figure 5.2. Acute Tx of anaphylaxis.

- Cat bites
  - Smaller puncture wounds, more likely to become infected. More likely to be pt's *own* pet, so delayed presentation more likely.
- Insect bites
  - Systemic reaction uncommon—horseflies, deerflies, and blackflies *can* cause systemic allergic reaction.

  - Mosquito bites can cause a local immune reaction (aka Skeeter syndrome).
  - Mosquito vectors: malaria, West Nile virus, yellow fever, dengue, filariasis.
  - Tick vectors: Rocky Mountain spotted fever, Lyme disease.
- Snake bites
  - Rare in Canada—exotic pets, species of rattle snakes in Southwestern Ontario, Southern BC, Southwestern Alberta, and Southern Saskatchewan.

APPROACH (Figures 5.3 and 5.4)

- Rabies prophylaxis
  - Indicated if animal/human has *confirmed* rabies, *suspicious* behavior, or *cannot be observed* for 10 d (see Clinical Box for high-risk species in Canada)

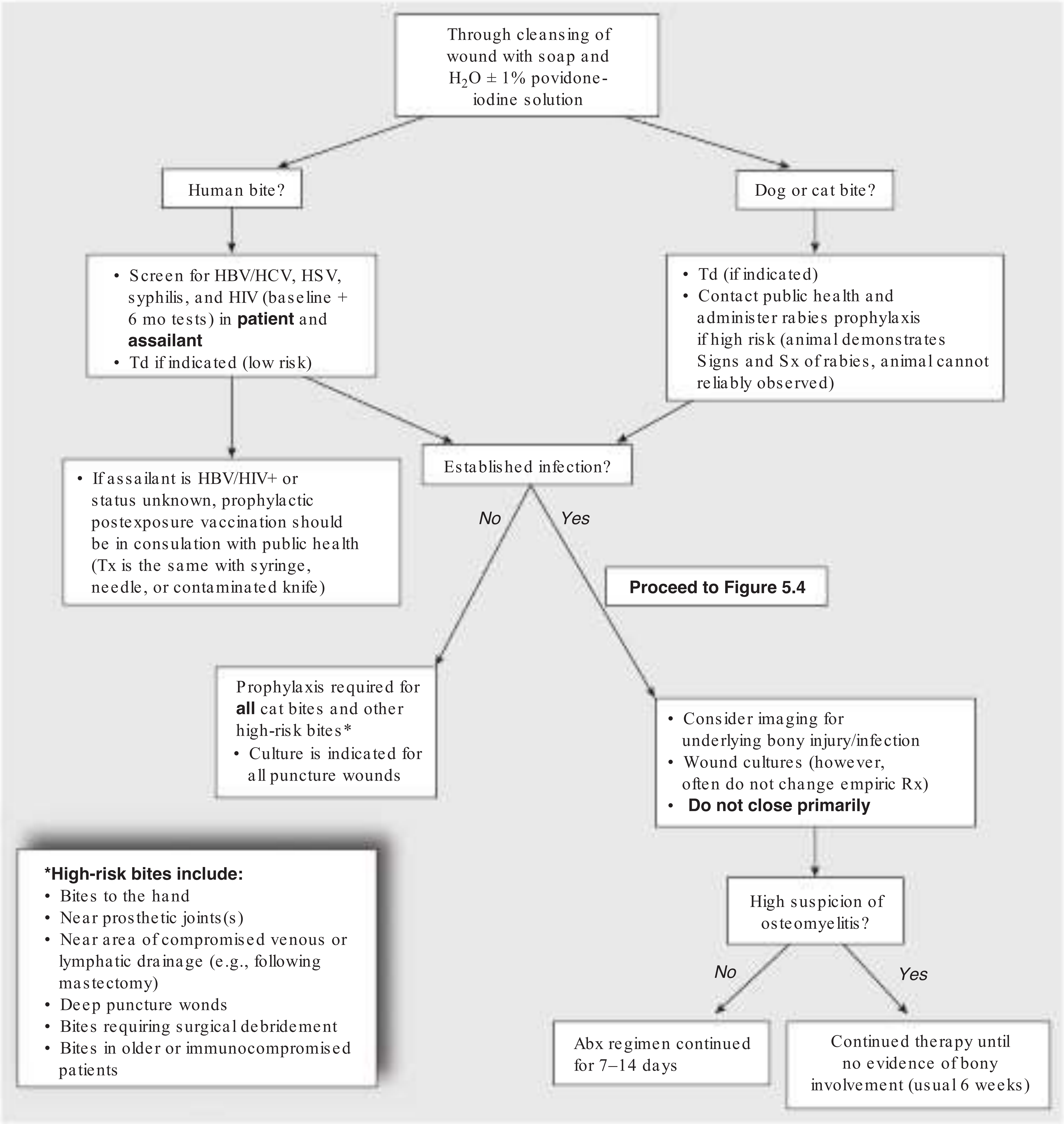
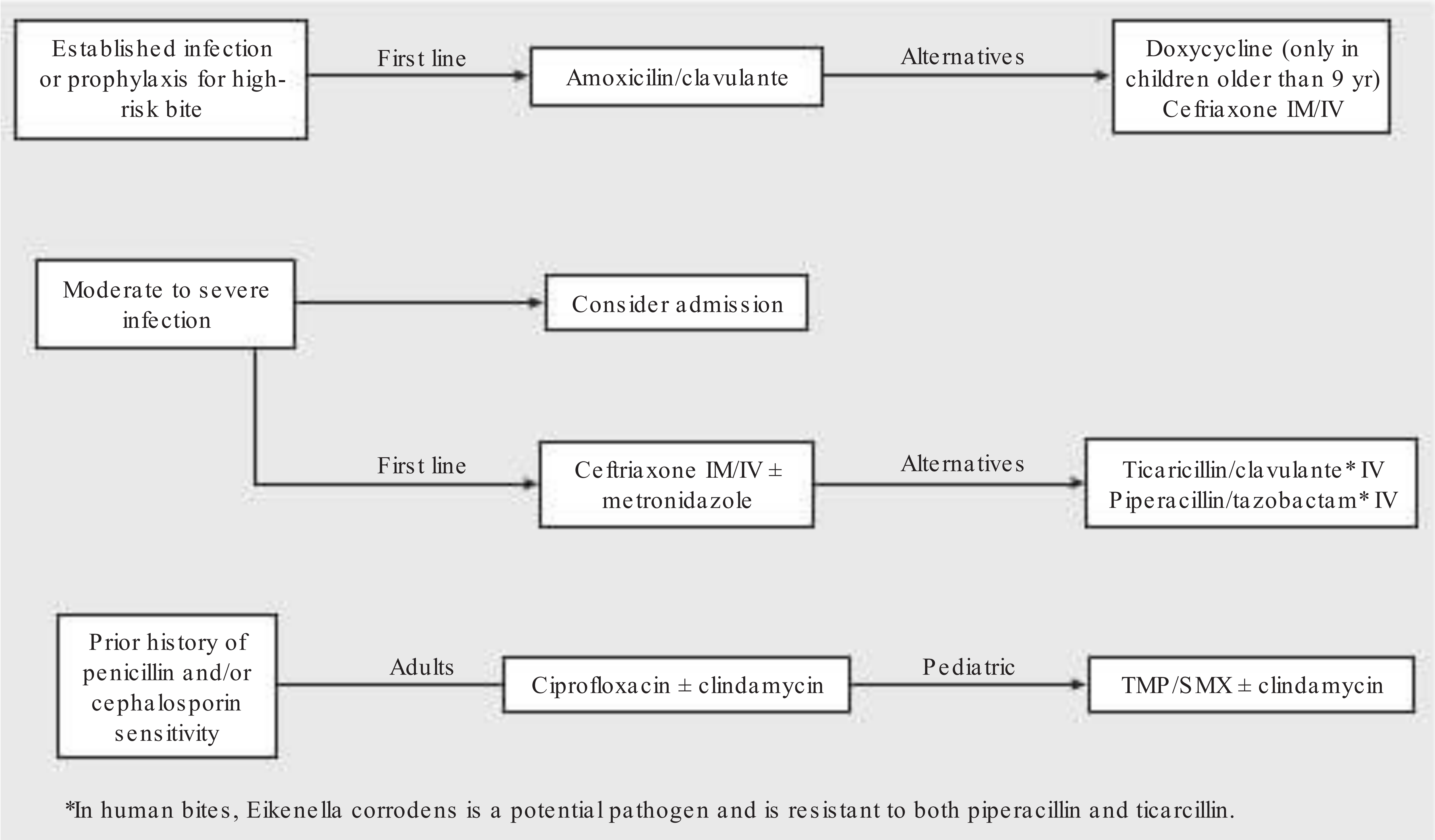

Through cleansing of wound with soap and H2O ± 1% povidone-iodine solution
Human bite?
Dog or cat bite?
• Screen for HBV/HCV, HSV, syphilis, and HIV (baseline + 6 mo tests) in patient and assailant
• Td if indicated (low risk)
• Td (if indicated)
• Contact public health and administer rabies prophylaxis if high risk (animal demonstrates Signs and Sx of rabies, animal cannot reliably observed)
• If assailant is HBV/HIV+ or status unknown, prophylactic postexposure vaccination should be in consulation with public health (Tx is the same with syringe, needle, or contaminated knife)
Established infection?
No
Yes
Proceed to Figure 5.4
Prophylaxis required for all cat bites and other high-risk bites*
• Culture is indicated for all puncture wounds
• Consider imaging for underlying bony injury/infection
• Wound cultures (however, often do not change empiric Rx)
• Do not close primarily
High suspicion of osteomyelitis?
No
Yes
Abx regimen continued for 7–14 days
Continued therapy until no evidence of bony involvement (usual 6 weeks)
*High-risk bites include:
• Bites to the hand
• Near prosthetic joints(s)
• Near area of compromised venous or lymphatic drainage (e.g., following mastectomy)
• Deep puncture wonds
• Bites requiring surgical debridement
• Bites in older or immunocompromised patients

Figure 5.3. Approach to human, dog, and cat bites (see Skin Wounds and Regional Anesthesia).


Established infection or prophylaxis for high-risk bite
First line
Amoxicilin/clavulante
Alternatives
Doxycycline (only in children older than 9 yr)
Ceftriaxone IM/IV
Moderate to severe infection
Consider admission
First line
Ceftriaxone IM/IV ± metronidazole
Alternatives
Ticaricillin/clavulante* IV
Piperacillin/tazobactam* IV
Prior history of penicillin and/or cephalosporin sensitivity
Adults
Ciprofloxacin ± clindamycin
Pediatric
TMP/SMX ± clindamycin

*In human bites, Eikenella corrodens is a potential pathogen and is resistant to both piperacillin and ticarcillin.

Figure 5.4. Appropriate Abx choice for human, dog, and cat bites. (Based on the 2005 edition of Anti-infective Guidelines for Community-acquired Infections.)

CLINICAL box

Wild Animals at Highest Risk of Rabies Transmission in Canada

Bats
Bobcats
Coyote
Fox
Raccoon
Skunk
Wolf

- Contact public health for vaccine and immunoglobulin
- Administration
  - Rabies Ig 20 unit/kg: half infused to wound and half in separate IM dose (*deltoid or buttock*)
  - Rabies vaccine 1 mL IM: give in opposite deltoid on days 0, 3, 7, 14, 21

FOR MORE INFORMATION ON RABIES IN CANADA

- Rabies information from the public health agency of Canada: http://www.phac-aspc.gc.ca/tmp-pmv/info/rage-eng.php
- Grill AK. Approach to management of suspected rabies exposure: what primary care physicians need to know. *Can Fam Physician*. 2009;55(3):247–251.

BURNS

MCC OBJECTIVE

Based on Objective #11 (Burns) of *Objectives for the Qualifying Examination,* 3rd edition.

OVERVIEW

- Burns are common and range from minor cutaneous lesions to life-threatening injuries.
- Major burns and the sequelae are a significant source of morbidity in survivors.

APPLIED SCIENTIFIC CONCEPT

- Burns result from interaction of current with resistance of tissues
- Systemic effects of burns: see Figure 5.5

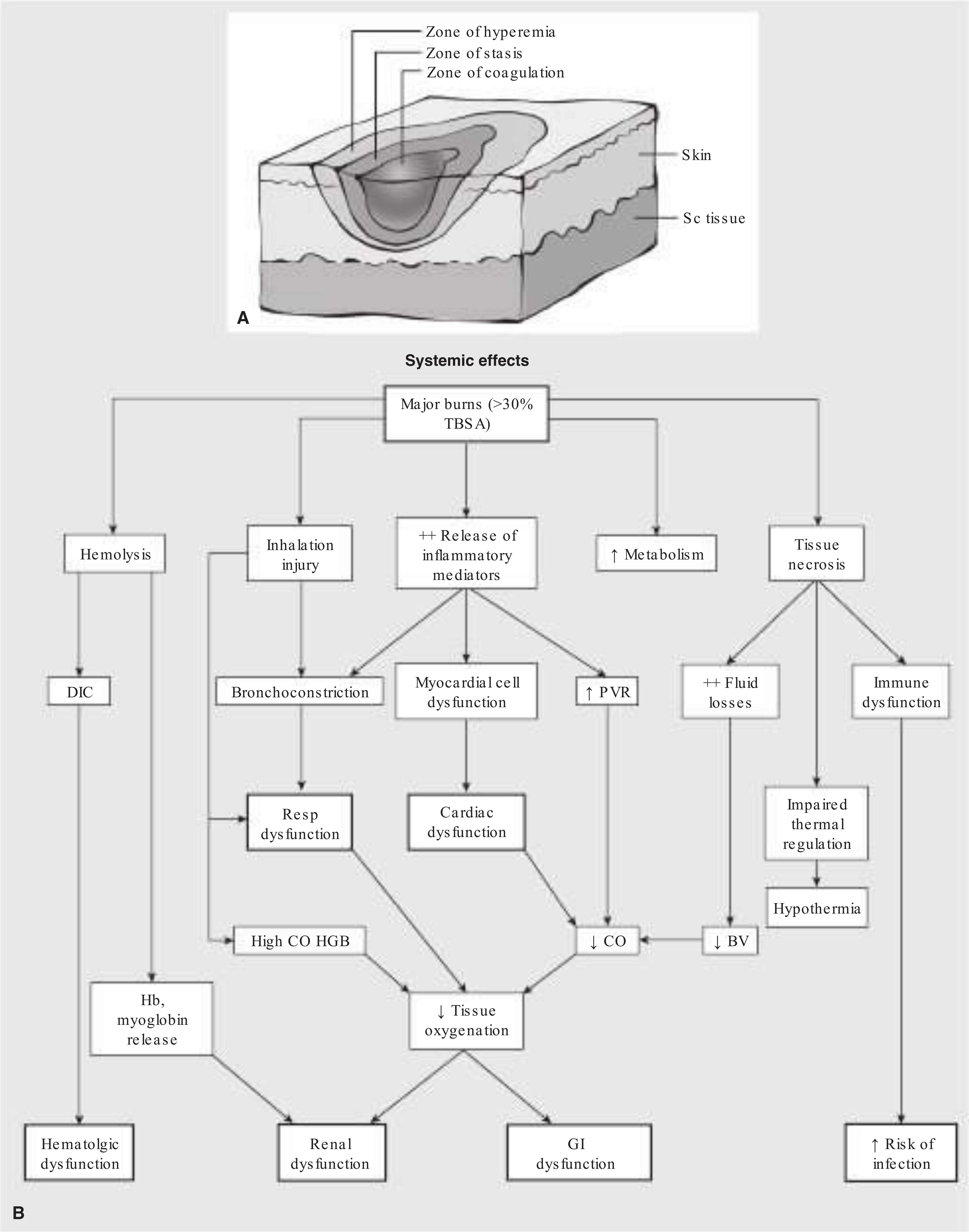


Figure 5.5. A: Local effects of thermal burns. Full thickness burns consist of three distinct zones of tissue. Zone of coagulation: white, charred central portion; consists of necrotic tissue. Zone of stasis: red, may blanch with pressure initially, but fragile blood supply may give way to AVN. Zone of hyperemia: red, blanches with pressure, and has intact blood supply. Healing takes place in first week. (Image excerpted from the O'Connell Smeltzer SC, Bare BG. Brunner and Suddarth's Textbook of Medical-Surgical Nursing. 9th ed. Philadelphia, PA: Lippincott Williams & Wilkins, 2000.) B: Systemic effects of thermal burns. (Image modified from the O'Connell Smeltzer, Bare BG. Brunner and Suddarth's Textbook of Medical-Surgical Nursing. 9th ed. Philadelphia, PA: Lippincott Williams & Wilkins, 2000.)

CAUSAL CONDITIONS

Thermal Burns

- Types: fire (flash, flame), contact, and scalds (grease, steam, liquids, immersion)
- The depth of thermal burns is dependent on the following:
  - Contact temperature
  - Duration of contact with heat source
  - Thickness of skin involved

Electrical Burns (Table 5.3)

TABLE 5.3 • Electrical burns

Cardiac	Arrhythmia in 15%—usually benign rhythms; however, may result in VFib
MSK	Greatest injury in muscle/ligament/bone due to high resistance of these tissues may result in compartment syndrome ± rhabdo
Renal	High concentration of CK combined with fluid losses may result in ATN Tx: ++ fluids ± urinary alkalinization
CNS	LOC, paralysis, Resp depression, amnesia: All are usually transient
Eye	Lightening: cataracts and keraunoparalysis with fixed, dilated pupils

- Types: low voltage, high voltage, and lightning
- DC: short duration of contact, but ↑ risk of trauma because victim is often thrown from the source
- AC: Exposure can be prolonged because source repetitively stimulates muscle contraction
- The extent of an electrical injury is dependent on the following variables:
  - Voltage
  - Current strength
  - Resistance to flow
  - Duration of contact with the source
  - Pathway of electrical energy flow (i.e., potential structures injured)
  - Type of current

Chemical Burns

- Types: acid versus alkali
- Specific agents associated with specific systemic effects:
  - Hypocalcaemia: oxalic acid, hydrofluoric acid
  - Nephrotoxicity: tannic acid, phosphorus
  - CNS depression and hypotension: phenol
  - Liver failure, ATN, death: dichromate poisoning
- Tx: +++ water irrigation. *Do not* "neutralize" with acid/alkali as the exothermic reaction can worsen burn. First priority is to completely remove the offending agent. Low pressure (e.g., tap water) is appropriate and safe. If an exposure has occurred in a lab or in an industrial setting, review the MSDS if able to determine if special treatments are recommended.

ASC box

Coagulation versus Liquefaction

Alkali burns more than acid burns because alkali dissolves protein and collagen (liquefaction) penetrating deeper than acid burns

Radiation Burns

- Types: UV, medical/therapeutic
  - Exposure through skin or ingestion/inhalation
  - GI and hematologic systems are most affected: rapidly dividing cells
  - CNS affected if high enough dose exposure
  - Best prognostic indicator: absolute lymphocyte count within 48 h of a whole body exposure
- Tx: remove clothing and irrigate. Supportive/symptomatic management.
- If inhalational/ingestion exposure suspected, chelating or blocking agents may help.

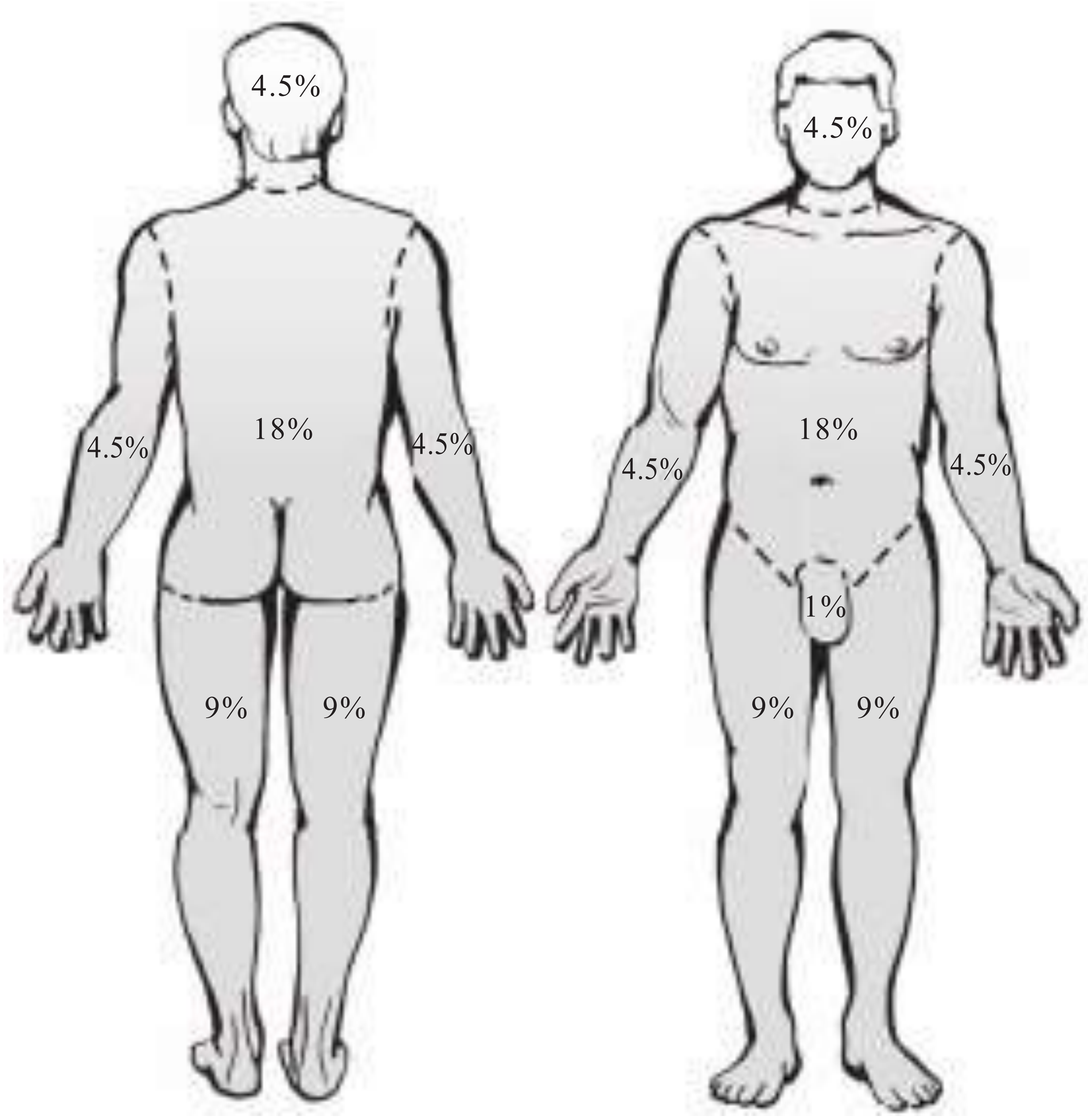
APPROACH

Diagnosis

- Assessment of percentage of body surface area burned: see Figure 5.6
- Depth of burns: see Table 5.4

Management

Superficial/Partial Thickness with No Indications for Transfer to Burn Center (Figure 5.6)



Estimating TBSA

- "Rule of 9's" commonly used. Body surfaces are broken into multiples of 9 (see diagram)
- Patient's hand approximates 1% of TBSA
- Rule of thumb: contribution of head in children > adults and contribution of legs in children < adults

Head

18% (infants) → 14% (child) → 9% (adult)

Each leg

14% (infant) → 16% (child) → 18% (adult)

Indications to Transfer to Burn Center

- Partial Thickness >10% BSA
- Burns that involve the face, hands, feet, genitalia, perineum, major joints
- Any third degree burns
- Electrical (including lightning) of Chemical burns
- Preexisting medical condition with potential impact on recovery
- Concomitant trauma where burn = worst thing
- Children in hospitals without pediatric resources
- If special emotional/social/rehab required

Figure 5.6. Estimating TBSA. Image excerpted from the Emergency Series.

TAbLE 5.4 • Depth of burns

	Classification of Burns			
	Superficial (First Degree)	Superficial-Partial Thickness (Superficial Second Degree)	Deep Partial Thickness (Deep Second Degree)	Full Thickness (Third Degree)
Appearance	Red	Red/blanched white, fluid-filled blisters	White & leathery or black & charred	White & leathery or black & charred
Layers involved	Epidermis	Epidermis, superficial (papillary) ± deep (reticular) dermis	Epidermis, both layers of dermis	Epidermis, dermis, and subcutaneous tissues (fascia/muscle/bone)
Presentation	++ Painful, tender to touch, intact 2-point discrimination	++ Painful, tender to touch, 2-point discrimination intact or diminished	Numb, loss of 2-point discrimination	Numb, loss of 2-point discrimination
Healing potential	Complete several days	± Scarring, may be hypertrophic with contractures across joints Healing ~2 wks	Extensive time to heal (3–4 wks) but many pts require wound excision and skin grafting	Extensive debridement, reconstruction of specialized tissues, skin grafting

CLINICAL box

Signs of Upper Airway and/or Inhalational Injury

- Hx enclosed fire/flame exposure (i.e., inhaling supra-heated gas in a confined space)
- Burns to neck/face
- Singed eyebrows/facial hair/nares
- Stridor/inspirational grunting
- Hoarseness
- Burns to oropharynx mucosa
- Cough, soot-tinged sputum
- Resp distress, low Spo_2, accessory muscle use
- Crackles, wheeze, rhonchi
- Circumferential burns to chest or neck
- Cardiac instability/ischemia

CLINICAL box

Treatment of Inhalational Injury

- Consider early intubation if signs of serious upper airway edema are present
- 100% O_2 to decrease half-life of CO-Hbg in blood
- Consider use of hyperbaric O_2 and/or oscillator ventilator

CLINICAL box

Intentional Injury

High index of suspicion if:

- Burns to back of hands/feet, buttocks, perineum, legs
- Well-demarcated edge (immersion)
- Unexplained delays in seeking medical attention
- Other evidence of intentional injury/abuse (see Pediatrics)

- Stop the burning process—remove from source, brush off excess contamination, remove clothing, begin flushing with +++ warm water (avoid causing hypothermia)
- Reduce risk infection
  - Use a clean water source (e.g., tap water or sterile saline)
  - Td immunization if indicated
  - Consider blister debridement in the following situations (controversial, when in doubt ask the referring burn surgeon):
    - Infected or grossly contaminated
    - Hemorrhagic
    - Large, tense that impede a joint's range of motion
    - Circumferential digit blisters
  - Dressings—the choice of dressing depends on the size, depth, and location of the burns. Any topical creams used should have good antimicrobial effects without the risk of allergic reactions. The cream should be easily removed from the burned area in order to provide good visibility of wound bed. Best options at present are neomycin/polymyxin B or Bacitracin creams. Most experts recommend avoiding 1% silver sulfadiazine for the above reasons.
- Appropriate discharge instructions—return if signs infection or not healing within appropriate time frame

Partial/Full Thickness (or Burn with Indication for Transfer to Burn Center)

Primary Survey

- ABCs
  - **Airway**—initiate 100% O_2 and Spo_2 monitoring. Have a low threshold for intubation if there are signs of a serious upper airway burn and/or inhalational injury (see Clinical Box, Signs of Upper Airway and/or Inhalational Injury). Supraglottic edema can lead to rapid loss of airway.
  - **Breathing**—positive pressure ventilation may be required for bronchoconstriction and inhalational injury. Think about CO or cyanide toxicity in pts who have had significant smoke inhalation.
  - **Circulation**—two large-bore IVs (in unburned skin if possible) for rapid volume infusion. Use Parkland formula for first 24 h (see Clinical Box, Parkland Formula).
- Stop the burning process—remove from source, brush off excess contamination, remove clothing, begin flushing with ++++ warm water (avoid causing hypothermia)

Secondary Survey

- *ABCDEFGHI* (note: not the order in which they should be performed)
  - A-nalgesia—high-dose narcotics may be needed. Remember that agitation may indicate pain
  - B-urn characteristics—depth, TBSA, body weight for calculation of fluid requirements
  - C-atheter (urinary)—for following urine output to monitor adequacy of resuscitation
  - D-ressings and wound care—clean all burn areas and cover with occlusive/clean dressings on consultation with burn service as local practices may vary. Do *not* use wet dressings due to risk of hypothermia
  - E-scharotomy—consider for circumferential burns to avoid distal ischemia or Resp compromise if around thorax. Should be done by an experienced burn surgeon. Consider Doppler to assess distal blood flow
  - F-luids—Parkland formula, follow urine output and vital sign normalization
  - **F**asciotomy—if signs compartment syndrome. Should be done by an experienced burn surgeon

- G-astric tube—burns > 20% BSA can develop an ileus lasting 4 to 5 d. Also increased metabolic rate requires nutritional support
- H-istory—PMHx, allergies, events around injury, exposures, consider intentional injury in pediatrics
- I-mmunization—Td prn

Investigations

- CBCD, lytes, BUN, Cr, glu, INR, PTT, ABG with CO-Hgb, B-HCG
- ECG, CK-MB, trop, U/A for urine Mgb
- Type and screen if anticipate OR debridement
- CXR, CT head if altered LOC, bronchoscopy if suspect serious inhalation injury

FOR MORE INFORMATION

- European burn guidelines: Brychta P, Magnette A. *European Practice Guidelines for Burn Care*. The Hague, The Netherlands: PAM Committee of European Burns Association; 2010.

CLINICAL box

Parkland Formula

Fluid required (mL RL) = 4 × body wt (kg) × % TBSA (partial and full thickness only)

- Half in first 8 h from time of injury
- Half over the next 16 h
- Electrical and full thickness require more fluids
- Only an approximation: adjust based on urine output (adult = 0.5 mL/kg/h, child = 1 mL/kg/h, infant = 2 mL/kg/h) and vital sign abnormalities

FACIAL INJURIES

MCC OBJECTIVE

Based on Objective #109-8 (Facial Injuries) of *Objectives for the Qualifying Examination,* 3rd edition.

OVERVIEW

- Assessment and protection (as needed) of the airway is always the first priority.
- Facial injuries are often missed on secondary survey in pts with multisystem trauma.
- Missed injures can have significant functional and cosmetic outcomes.

CAUSAL CONDITIONS

- Be sure to consider intimate partner violence and nonaccidental trauma

APPROACH

Assessment and management of facial injuries (Figure 5.7)

Management

- First priority is securing the airway, if necessary
- Analgesia
- *Do not* place NG tube if suspect basal skull fracture
- Immediate referral for any suspected globe injury (*place eye shield)*, extraocular muscle entrapment, or unstable fracture of midface

FOR MORE INFORMATION ON ASSESSMENT AND MANAGEMENT OF PATIENTS WITH FACIAL FRACTURES

- Ellis E, Scott K. Assessment of patients with facial fractures. *Emerg Med Clin North Am*. 2000;18(3):411–488.

FOR MORE INFORMATION ON THE ASSESSMENT AND MANAGEMENT OF ORBITAL TRAUMA

- Bord S, Linden J. Trauma to the globe and orbit. *Emerg Med Clin North Am*. 2008;26(1):97–123.

CLINICAL box

Key Questions on History

Does your bite feel "normal"?—screen for malocclusion

Do you have any numbness?—screen for trigeminal nerve injury, especially for fractures near nerve exit points

Are you seeing double?—screen for orbital fractures/impaired EOMs

Adapted from Ellis E III, Scott K. Assessment of patients with facial fractures. Emerg Med Clin North Am. 2000;18(3):411–488.

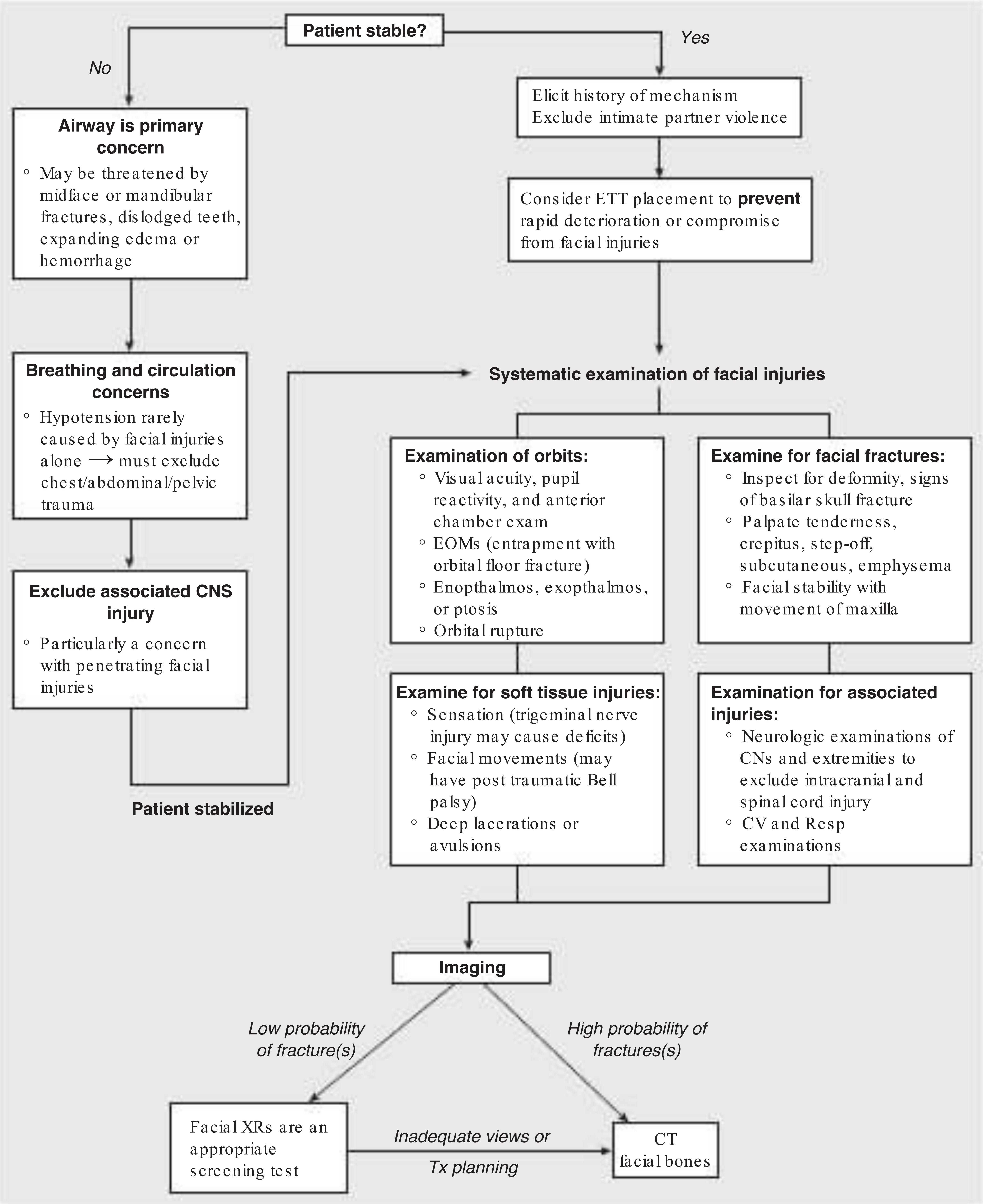

Patient stable?
No
Yes
Airway is primary concern
◦ May be threatened by midface or mandibular fractures, dislodged teeth, expanding edema or hemorrhage
Breathing and circulation concerns
◦ Hypotension rarely caused by facial injuries alone ⟶ must exclude chest/abdominal/pelvic trauma
Exclude associated CNS injury
◦ Particularly a concern with penetrating facial injuries
Patient stabilized
Elicit history of mechanism
Exclude intimate partner violence
Consider ETT placement to prevent rapid deterioration or compromise from facial injuries
Systematic examination of facial injuries
Examination of orbits:
◦ Visual acuity, pupil reactivity, and anterior chamber exam
◦ EOMs (entrapment with orbital floor fracture)
◦ Enopthalmos, exopthalmos, or ptosis
◦ Orbital rupture
Examine for facial fractures:
◦ Inspect for deformity, signs of basilar skull fracture
◦ Palpate tenderness, crepitus, step-off, subcutaneous, emphysema
◦ Facial stability with movement of maxilla
Examine for soft tissue injuries:
◦ Sensation (trigeminal nerve injury may cause deficits)
◦ Facial movements (may have post traumatic Bell palsy)
◦ Deep lacerations or avulsions
Examination for associated injuries:
◦ Neurologic examinations of CNs and extremities to exclude intracranial and spinal cord injury
◦ CV and Resp examinations
Imaging
Low probability of fracture(s)
High probability of fractures(s)
Facial XRs are an appropriate screening test
Inadequate views or Tx planning
CT facial bones

Figure 5.7. Approach to facial injuries.

HYPERTHERMIA

MCC OBJECTIVE

Based on Objective #107-1 (Hyperthermia) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Hyperthermia is a pathologic state, as opposed to fever that is adaptive.
- Pts' capacity to accommodate elevated body temperature depends on a variety of host and environmental factors.
- Treatment should focus on cooling techniques (do not overshoot) and minimizing the risk of future heat illness.

APPLIED SCIENTIFIC CONCEPT

- An elevation in core body temperature > 38°C that is *not* due to fever.
- Fever is an adaptive, cytokine-mediated response, whereas hyperthermia reflects a thermoregulatory failure.
- Hyperthermia is "a rise in body temperature above the hypothalamic set point when heat-dissipating mechanisms are impaired (by drugs or disease) or overwhelmed by external (environmental or induced) or internal (metabolic) heat" (Figure 5.8).

ASC box

Methods of Heat Loss

Radiation—transfer of heat via electromagnetic waves

Conduction—direct contact with a cooler surface

Convection—air or liquid moving across an object

Evaporation—vaporization of sweat (note: This does not work well in a humid environment.)

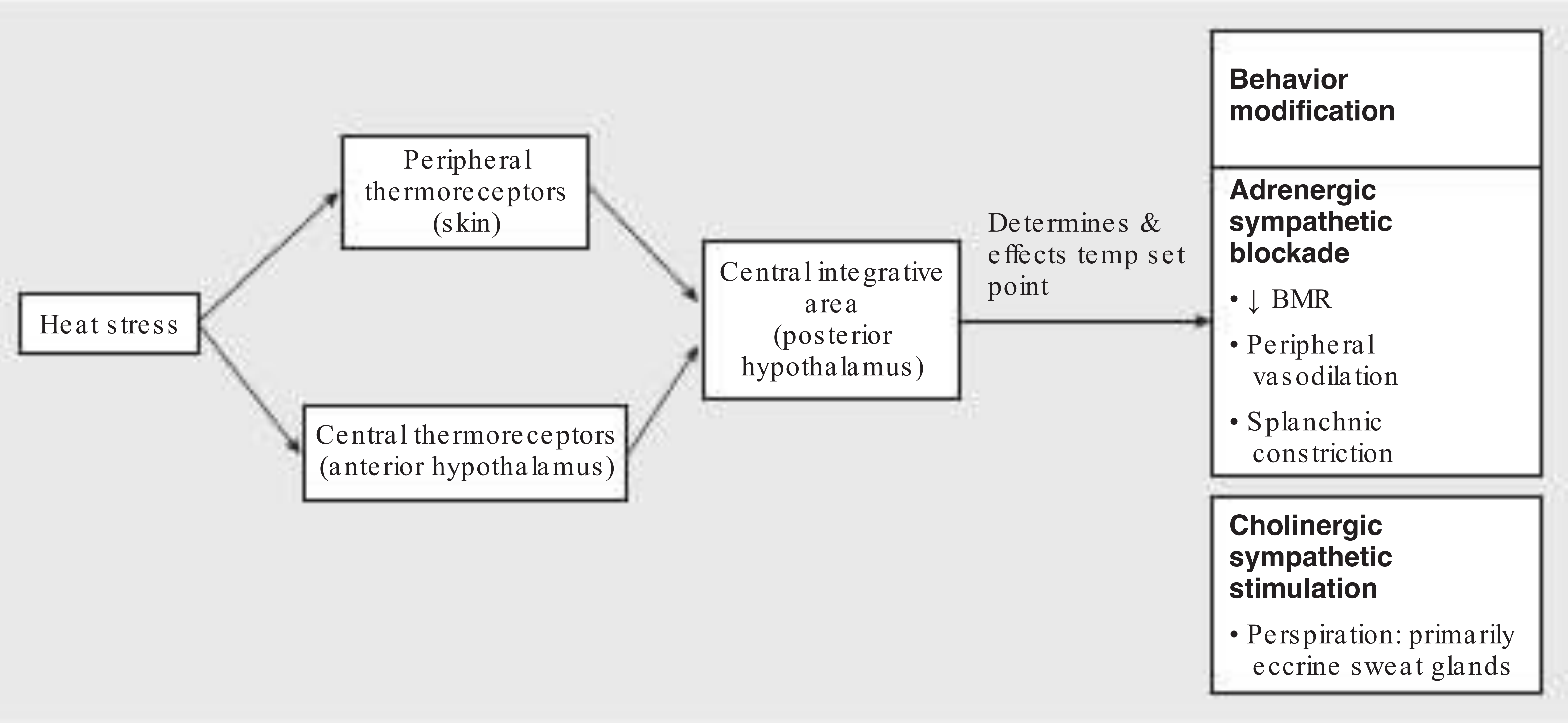

Heat stress
Peripheral thermoreceptors (skin)
Central thermoreceptors (anterior hypothalamus)
Central integrative area (posterior hypothalamus)
Determines & effects temp set point
Behavior modification
Adrenergic sympathetic blockade
• ↓ BMR
• Peripheral vasodilation
• Splanchnic constriction
Cholinergic sympathetic stimulation
• Perspiration: primarily eccrine sweat glands

Figure 5.8. Physiologic response to heat stress.

CAUSAL CONDITIONS

- **Increased heat load**
  - External
    - Exertional—heavy exercise or work in ↑ ambient temperature ± ↑ humidity
    - Prolonged exposure with the inability to adequately compensate (see Clinical Box, Risk Factors for Heat Illness/Decreased Thermoregulatory Capacity)
  - Internal
    - Malignant hyperthermia
    - Neuroleptic malignant syndrome
    - Thyroid storm
    - Pheochromocytoma
    - Serotonin syndrome
- **Decreased heat dissipation**
  - See Clinical Box for factors diminishing a pt's ability to dissipate heat

CLINICAL box

Risk Factors for Heat Illness/Decreased Thermoregulatory Capacity

Age: > 75, < 4 (i.e., extremes of age)

Obese

Drugs: anticholinergics, antipsychotics, antiparkinson, sedatives, cardiac meds

EtOH

↓ mobility (cannot get away from heat)

Hypothalamic disease (e.g., cerebral stroke)

APPROACH (Table 5.5)

TAbLE 5.5 • Physical exam findings of hypothermia

System	Physical Exam/Injury	Investigations
Cardiovascular	↑ HR ↑ BP initially, progressing to ↓ BP Arrhythmias Ischemic changes Heart failure	ECG Pt should be on cardiac & hemodynamic monitor
Resp	↑ RR Pulmonary edema Pulmonary hemorrhage	CXR, saturation monitor
Neurologic	Seizure/coma Cerebral edema Hypertonia: NMS/MH	CT head if concerned
GI	Liver failure Pancreatitis	ALT, AST, glucose, lactate Lipase
Renal	Renal failure: prerenal ± Rhabdo	U/A BUN, Cr, CK Urine myoglobin
Hematologic	Look for evidence of DIC Electrolyte abnormalities (early: ↓ K^+, ↑/↓ Na^+) (Late: ↑ K^+, ↓ Ca^{2+})	CBC—look for thrombocytopenia Lytes, INR, PTT, hemolytic workup

Diagnosis (Tables 5.6 and 5.7)

TAbLE 5.6 • Minor Heat Illnesses

Minor Heat Illnesses	Core Temperature . 37.5
Heat cramps	• Cramping of the most worked muscle groups • Caused by replacement with isotonic fluids after ++ perspiration
Heat edema	• Venodilation → orthostatic pooling → ↑ ADH/aldosterone • Commonly seen in nonacclimatized or elderly pts • Must R/O other causes of edema
Heat syncope	• Similar mechanism as heat edema • Commonly in the elderly • Must R/O other causes of syncope
Prickly heat rash/miliaria rubra/lichen tropicus/sweat rash	• Superficial pruritic vesicles on erythematous base • Generally confined to clothed areas

TABLE 5.7 • Significant heat illnesses

	Heat Exhaustion	Heat Stroke
Core temperature	37.5°–40.5°C	> 40.5°C
Key findings	• Mental function intact • Malaise, fatigue, headache • ↑HR, orthostatic hypotension, clinically dehydrated	CNS dysfunction (ataxia, coma, Sz) • Ataxia often 1st sign as the cerebellum is most sensitive to heat • 20% will have persistent neurologic dysfunction Liver dysfunction • Delayed 24–48 h—leaking of transaminases from centrilobular necrosis Up to 80% mortality if left untreated

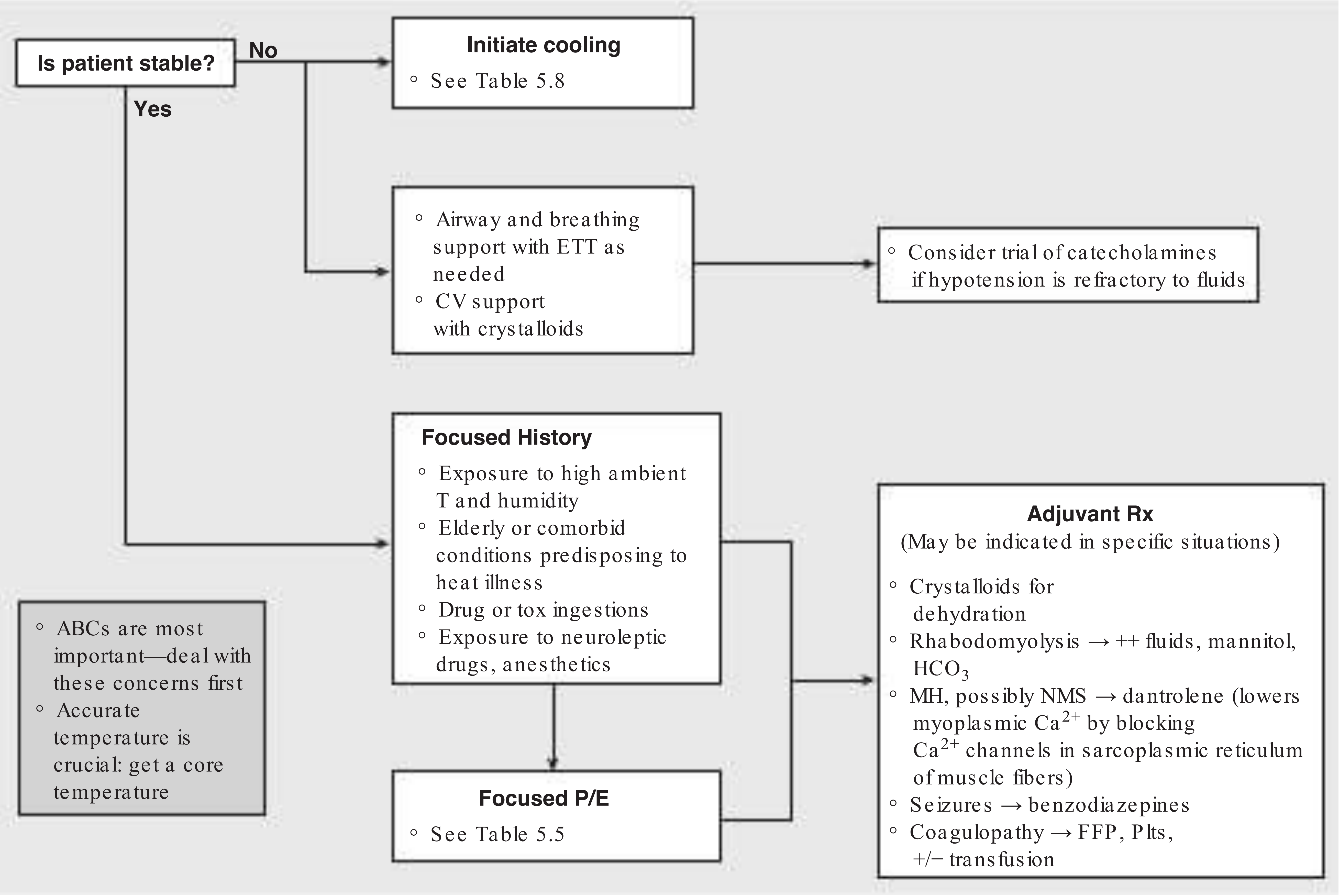

Is patient stable?
No
Yes
Initiate cooling
◦ See Table 5.8
◦ Airway and breathing support with ETT as needed
◦ CV support with crystalloids
◦ Consider trial of catecholamines if hypotension is refractory to fluids
Focused History
◦ Exposure to high ambient T and humidity
◦ Elderly or comorbid conditions predisposing to heat illness
◦ Drug or tox ingestions
◦ Exposure to neuroleptic drugs, anesthetics
Focused P/E
◦ See Table 5.5
Adjuvant Rx
(May be indicated in specific situations)
◦ Crystalloids for dehydration
◦ Rhabodomyolysis → ++ fluids, mannitol, HCO3
◦ MH, possibly NMS → dantrolene (lowers myoplasmic Ca2+ by blocking Ca2+ channels in sarcoplasmic reticulum of muscle fibers)
◦ Seizures → benzodiazepines
◦ Coagulopathy → FFP, Plts, +/− transfusion
◦ ABCs are most important—deal with these concerns first
◦ Accurate temperature is crucial: get a core temperature

Figure 5.9. Approach and Tx of severe hyperthermia.

Management (Figure 5.9 and Table 5.8)

FOR A MORE IN-DEPTH REVIEW OF THE PATHOPHYSIOLOGY AND MANAGEMENT OF HEAT STROKE

- Epstein Y, Roberts WO. The pathophysiology of heat stroke: an integrative view of the final common pathway. *Scand J Med Sci Sports*. 2011;21(6):742–748; Bouchama A, Knochel P. Heat stroke. *N Engl J Med*. 2002;346(25):1978–1988.

FOR MORE INFORMATION ON THE MANAGEMENT OF EXERTIONAL HEAT ILLNESS

- Smith JE. Cooling methods used in the treatment of exertional heat illness. *Br J Sports Med*. 2005;39:503–507.

TABLE 5.8 • Cooling techniques[a]

	Methods	Advantages	Disadvantages
First line	• Evaporation • Ice water submersion	• Rapid, whole body • Both minimize shivering (thermogenesis) • Peripheral vasoconstriction: good if pt is hypertensive	• Equipment needed • If pt is unstable, cannot actively resuscitate if submerged
Acceptable adjuncts	• Ice packs to axilla/groin • Cooling blankets • Cardiopulmonary bypass (ECHMO)	• Icepacks inexpensive & available • CPB for refractory cases	• CPB: specialized centers only
Not recommended	• Gastric/rectal/peritoneal/urinary lavage with cool fluids • Cold IV fluid infusion		• No evidence and labor intensive • Cold fluids—complications/worsen preexisting edema

[a] Recommend stopping all cooling efforts at 39°C to avoid overshooting and hypothermia.

HYPOTHERMIA

MCC OBJECTIVE

Based on Objective #107-5 (Hypothermia) of *Objectives for the Qualifying Examination,* 3rd edition.

OVERVIEW

- Hypothermia can be caused by host factors or cold exposure.
- Rule out a medical cause.
- As a rule, resuscitation should *not* be stopped until pt's core temperature is at least 35°C.

APPLIED SCIENTIFIC CONCEPT

- Core temperature < 35°C.
- There is a disruption in the balance between heat production and heat dissipation (see ASC Box in hyperthermia for methods of heat loss).
- Pathophysiology (Figure 5.10).

CAUSAL CONDITIONS (Table 5.9)

APPROACH

Hx

Concomitant EtOH/other tox, Hx of previous illness, namely thyroid disease, CV/Resp disease, neuromuscular or CNS disease, endocrinologic etiologies such as adrenal insufficiency, and hypopituitarism.

P/E

- Temperature determination is crucial; rectal temperature is the most accurate; oral temperature is typically 0.5 less and affected by food/fluids, breathing patterns, smoking; and axillary temperature is typically 1.0 less and the least accurate. With

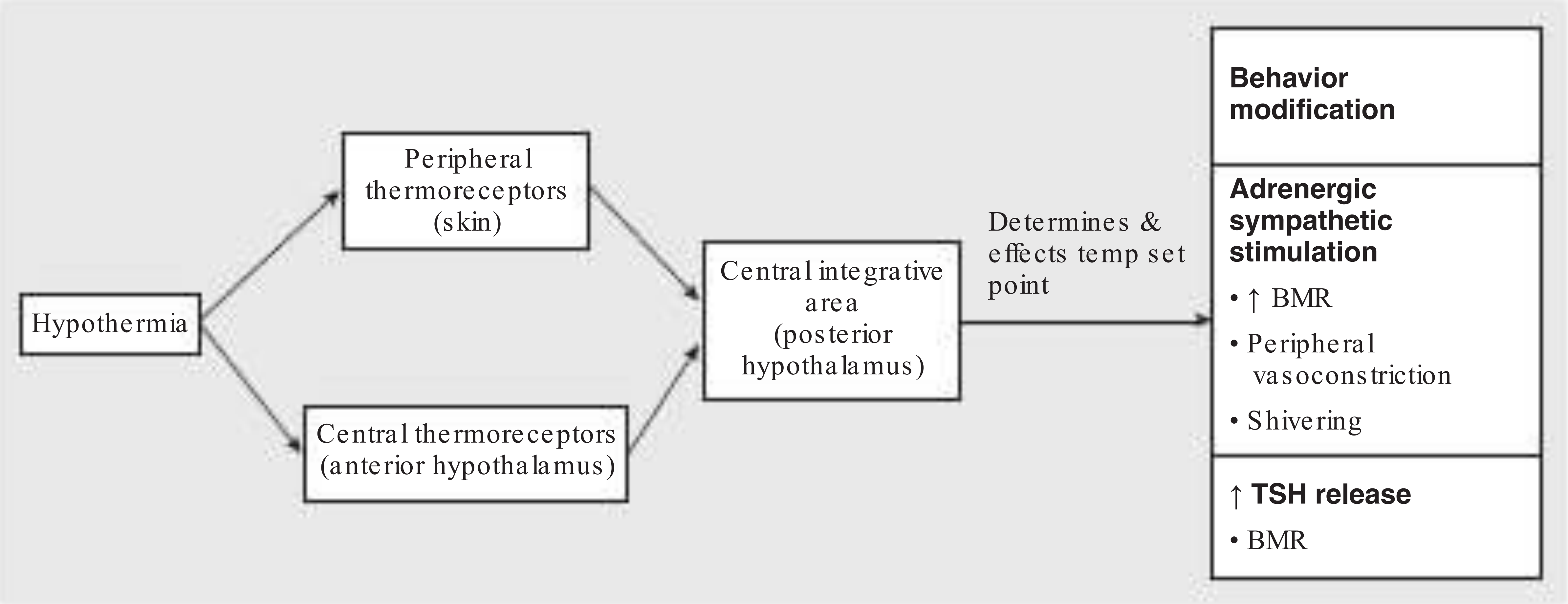

Hypothermia
Peripheral thermoreceptors (skin)
Central thermoreceptors (anterior hypothalamus)
Central integrative area (posterior hypothalamus)
Determines & effects temp set point
Behavior modification
Adrenergic sympathetic stimulation
• ↑ BMR
• Peripheral vasoconstriction
• Shivering
↑ TSH release
• BMR

Figure 5.10. Response to hypothermia.

TAbLE 5.9 • Causes of Hypothermia

↓ Heat Production

- **Endocrine**
  - Hypopituitarism
  - Hypothyroidism
  - Adrenal insufficiency
- **Insufficient Fuel**
  - Hypoglycemia
  - Malnutrition
- **Neuromuscular Inactivity**
  - Age
  - ↓ shivering

↑ Heat Loss

- **Accidental**
  - Exposure to cold air/water
- **Vasodilation**
  - Drugs
  - EtOH
  - Sepsis
- **Skin Breakdown**
  - Burns
  - Dermatitis
- **Iatrogenic**
  - Infusion cold fluids
  - Pt uncovered for long period of time

Impaired Thermoregulation

- **Central**
  - **Metabolic**
    - Cirrhosis
    - Uremia
  - **Drugs**
    - Barbiturates
    - Phenothiazines
    - Tricyclics
    - Insulin
  - **CnS**
    - Stroke
    - Trauma
    - SAH
    - Parkinsonism
    - Hypothalamic dysfunction
    - MS
- **Peripheral**
  - Spinal cord injury
  - Neuropathy
  - DM
  - Neuromuscular disease

temperatures less than 35°C, most routine commercially available thermometers are not accurate. For moderate and severe hypothermia, special thermometers are used to accurately determine the temperature (i.e., esophageal or intrabladder temp probes).

- Focus on CNS, CVS, and Resp exams I would suggest.

Labwork/Investigations

CBC, Lytes, gluc, INR/PTT, ABG, amylase, ECG, CXR

Tx

- See algorithm mentioned in the subsequent text
- Handle the pt gently, as the myocardium can be quite irritable

Management (Figure 5.11)

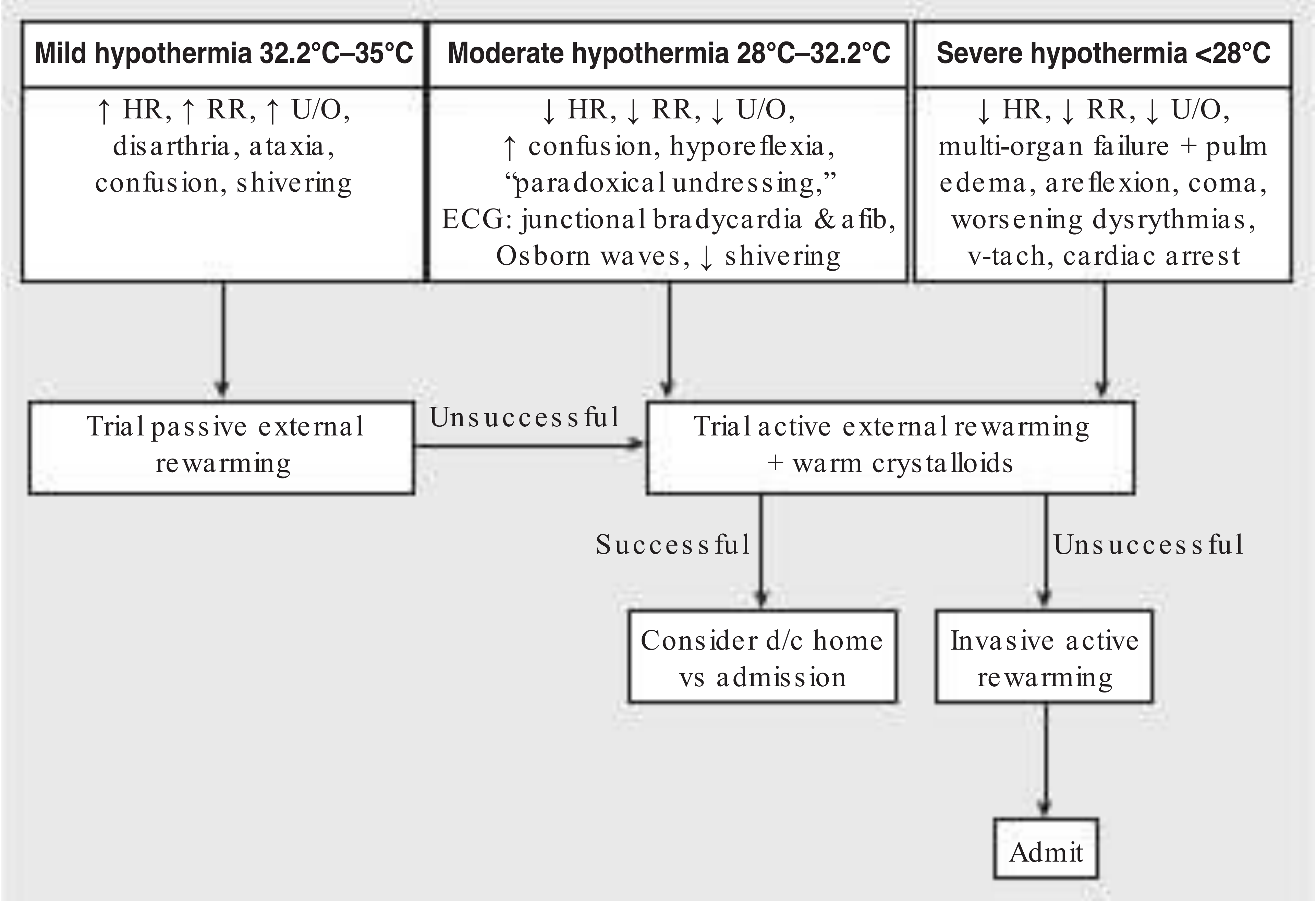

Mild hypothermia 32.2°C–35°C
↑ HR, ↑ RR, ↑ U/O, disarthria, ataxia, confusion, shivering
Moderate hypothermia 28°C–32.2°C
↓ HR, ↓ RR, ↓ U/O, ↑ confusion, hyporeflexia, "paradoxical undressing," ECG: junctional bradycardia & afib, Osborn waves, ↓ shivering
Severe hypothermia <28°C
↓ HR, ↓ RR, ↓ U/O, multi-organ failure + pulm edema, areflexion, coma, worsening dysrythmias, v-tach, cardiac arrest
Trial passive external rewarming
Unsuccessful
Trial active external rewarming + warm crystalloids
Successful
Unsuccessful
Consider d/c home vs admission
Invasive active rewarming
Admit

Figure 5.11. Management of hypothermia.

FOR INFORMATION ON MANAGEMENT OF SUPERFICIAL COLD INJURY (FROSTBITE)

- Hallam M, Cubison T, Dheansa B. Managing frostbite. *BMJ.* 2010;341:c5864.

FOR MORE INFORMATION ON HYPOTHERMIA

- McCullough L, Arora S. Diagnosis and treatment of hypothermia. *Am Fam Physician.* 2004;70(12):2325–2332.

POISONING

MCC OBJECTIVE

Based on Objective #77 (Poisoning) of *Objectives for the Qualifying Examination,* 3rd edition.

OVERVIEW

- Poisonings and drug overdoses are a common presentation to the emergency department.
- Household products, over-the-counter medications, and illicit substances are all common.
- It is important to take a thorough history and consider co-ingestions.
- Treatment is largely supportive, with some specific antidotes available.
- Call poison control.

APPLIED SCIENTIFIC CONCEPT

- Poisonings are common, representing 5% to 10% of ED visits and > 5% ICU admissions.
- > 50% occur in pts < 6 yr of age, and > 90% of poisonings occur in the home.
- > 80% in children are unintentional, and child-proof packaging legislation has had a significant impact on the number of pediatric deaths.

CAUSAL CONDITIONS

- As household products make up approximately 30% of poisonings, ask about cleaning products (detergents, soaps, household cleaners), cough and cold remedies, cosmetics, plants.
- There are many possible toxins: approach based on toxidrome category.
  - **Anticholinergic**—antihistamines, TCAs, phenothiazines, atropine
  - **Serotonergic**—insecticides, nerve agents, nicotine, pilocarpine, urecholine
  - **Cholinergic**—heroin, morphine, benzodiazepines, barbiturates, meprobamate, EtOH
  - **Opioid/sedative/hypnotics**—MAOIs, SSRIs, meperidine, TCA, benzodiazepines, l-tryptophan
  - **Sympathomimetics**—cocaine, amphetamines, MDMA, ephedrine, theophylline
- Do not forget about *withdrawal* symptoms as can often present like a toxic ingestion, especially benzodiazepine and alcohol.

APPROACH

History

- Unreliable—get collateral from witnesses, family, police/EMS regarding access to prescription Rxs and bottles, needles, smells, suicide note found on scene
- *Ask*: What was taken? How much (How many pills missing)? Route? Time of ingestion? What drugs/chemicals were present on seen? Rxs of family members/roommates?
- *Consider*: potential for delayed toxicity, potential severity
- Get standard Hx: PMHx, *all*, psychiatric history

Physical Exam

- ABCs—vitals give important clues to toxin involved.
- Look for stigmata of IVDU and/or chronic drug use, signs of emesis (possible aspiration), signs of trauma (do not assume all LOC due to ingestion, may still require imaging of head).
- Does the pt have odors suggestive of specific poisoning?
- Do vital sign abnormalities and physical findings suggest a specific toxidrome?

Investigations

- *Blood work*: CBC, lytes, glu, BUN, Cr, liver panel (including LFTs), venous/arterial blood gas, B-HCG, serum osmolarity, acetaminophen, ASA, EtOH
- *Urine tox screen*: not generally acutely helpful (unless spot test available), but may help with ongoing management for pts getting admitted who go on to have a protracted course
- ECG
- *CXR/AXR:* for radio-opaque ingestions **BAT CHIPS**

Diagnosis

- Based on history, physical exam, and investigations. Remember that if the clinical picture does not make sense, consider mixed overdose as co-ingestions are common (Table 5.10).
- Calculate the anion gap (see Clinical Box for calculation and Table 5.11 for interpretation).
- The presence of unmeasured osmoles in the setting of acute ingestion may indicate a potentially lethal OD. Unmeasured osmoles are detected by calculating the osmolar gap (see Clinical Box).
  - Causes of elevated osmolar gap: EtOH, isopropyl alcohol, ethylene glycol, methanol, ethanol (see Red Flag).

CLINICAL box

BAT CHIPS—
Radio-Opaque Ingestions

Barium
Antihistamines
TCAs
Calcium, Chloral hydrate, CCl_4
Condoms/Cocaine
Heavy metals
Iron
Potassium/Phenothiazine
Salicylates/Slow release

TABLE 5.10 • Presentation of various toxidromes

Toxidrome	Vitals	LOC	Pupils	Bowel Sounds	Skin	Other
Anticholinergic	BP: ↑ HR: ↑ RR: ± Temp: ↑	Delirium	↑	↓	Dry, red	"Hot as a hare, dry as a bone, red as a beet, blind as a bat, mad as a hatter"
Cholinergic	BP: ± HR: ± RR: ↑ Temp: N	N/depressed	± (nicotinic—pupil dilates/ muscarinic—pupil constricts)	↑	Wet	Sludge (muscarinic symptoms—salivation, lacrimation, urination, diarrhea, gastrointestinal distress, emesis), the Killer Bs (bronchospasm and bronchorrhea), and fasciculations/muscle cramps (nicotinic symptoms)
Opioids & sedative/hypnotics	All decreased	Depressed		↓	N	↓ reflexes ataxia
Serotonergic	BP: labile HR: ↑ RR: ↑ Temp:↑	Tremor Agitation Hallucination		↑	Wet	↑ reflexes, vomiting
Sympathomimetics	All increased	Agitated, increased psychomotor activity	↑	↑	Wet	Tremors, seizures
Withdrawal of sedatives/EtOH	All increased	Agitated Hallucinations	↑	↑	Wet	Tremor, seizures
Withdrawal of opioids	All usually increased, but temp may be normal or ↑	Anxious	↑	↑	Wet	GI upset, yawning, rhinorrhea, piloerection

TABLE 5.11 • Interpretation of the anion gap

Elevated AG Acidosis *"MUDPILES"*	Narrow AG *"HARDUPS"*
Methanol	**H**yperventilation
Uremia	**A**cetazolamide, acids, Addison disease
Diabetic/alcoholic ketoacidosis	**R**enal tubular acidosis
Paraldehyde	**D**iarrhea
Isoniazide/Iron	**U**reterosigmoidostomy
Lactate	**P**ancreatic fistula
Ethylene Glycol	**S**aline
Salicylates	

  - In general see ↑ OG *before* AG in toxic alcohol ingestion.
- *CXR/AXR:* for radio-opaque ingestions **BAT CHIPS.**

Management

ABCDEF

- ABC—supportive care
  - Cardiac monitoring, oximetry, IV access, support oxygenation/ventilation, and cardiac output as necessary

!

Lethal ingestions can present with an initially normal OG, which occurs later in the course of ingestion. A RISK of deterioration is a reason to keep the pt in observation if suspect potentially lethal ingestion.

CLINICAL box

Anion gap = $[Na^+] - ([Cl^-] + [HCO_3^-])$ Normal 8 to 14

Osmolar gap = difference between measured serum osmolality and calculated serum osmolarity

$= (Osm_{meas}) - (Osm_{calc})$ Normal < 10 mOsm/L

$Osm_{calc} = 2(Na^+) + BUN + Glucose$

- Decontamination
  - If ingestion within 1 to 4 h, a sustained release formation or suspect bezoar formation in the context of a potentially lethal overdose (Table 5.12)

TABLE 5.12 • Methods of decontamination

Orogastric lavage	• Large orogastric tube (Ewald tube) flushed with ND or water to remove pills & ↓ gastric absorption	• ↑ role if bezoar or if large volume & high potential for toxicity
Whole bowel irrigation	• Use a balanced polyethylene glycol solution (e.g., Golytely or Colyte) given by NG/OG until toxins removed and/or rectal effluent clear	• Pt must be alert & cooperative. • Not in ileus or if concerned about obstruction
Activated charcoal/ multidose-activated charcoal	• Charcoal binds to drug and prevents systematic absorption	• Not useful for EtOH, hydrocarbons, caustics, metals • Pt must be able to protect airway

- Enhanced elimination
  - For specific toxic ingestions, options include hemodialysis, hemoperfusion, alkalinization of urine/diuresis
- Find an antidote
  - Call poison control
  - Administer antidote if available (see Clinical Box, Common Antidotes)
  - Psychiatry referral if intentional

Treatment of Common Toxic Ingestions (Table 5.13)

Common Antidotes

CLINICAL box

Antidotes	Toxin
N-Acetylcysteine (NAC)	Acetaminophen
Naloxone	Opioid overdoes
Vitamin K and/or prothrombin complex (e.g., Octaplex or Beriplex)	Warfarin
Fomepizole (aka 4-methyl pyrazole) or ethanol	Ethylene glycol/methadone
Benzodiazepines	Flumazenil
Oxygen	Carbon monoxide
Sodium bicarbonate	TCAs
IV calcium	Calcium channel blockers
Glucagon	b-Blockers
Atropine	Organophosphates/insecticides

TABLE 5.13 • Treatment of common toxic ingestions

	Rx of Common Toxic Ingestions		
	Pathophysiology	Clinical	Rx (in addition to ABCDEF)
Methanol	• Hepatic metabolism by alcohol dehydrogenase to formic acid • Depletion of folate stores	• ↓ LOC, ataxia, lethargy, coma (like EtOH) • Vision: blurry, ↓VA, "snowstorm" vision • Parkinsonism in late stage • Delayed presentation common: especially if co-ingestion with EtOH	• Fomepizole (or EtOH drip): competes for alcohol dehydrogenase ↓ • Hemodialysis for severe ingestions • Folate supplementation

Salicylates	• Early: Resp alkalosis 2° stimulation of CNS chemoreceptors
	• Late: metabolic acidosis
		• Toxic dose: 150 mg/kg
		• Severe toxic dose:
		  • > 300 mg/kg
		  • Symptom onset 3–8 h post ingestion
			• ++ Fluids
			• May need K^+, dextrose
			• Consider urinary alkalinization for moderate toxicity not qualifying for hemodialysis[1]
			• Hemodialysis for severe, refractory toxicity

Acetaminophen	• Metabolized in liver. Toxic metabolites conjugated using glutathione and excreted. • In OD, glutathione depleted → metabolites = hepato toxicity • Toxic dose > 150 mg/kg or > 7.5 g	• 4 Phases of toxicity: i. 24–48 h—GI upset and diaphoresis ii. D2–3—GI improves, mild abdo pain, transaminases begin to climb iii. D3–4—GI upset returns, jaundice, metabolic acidosis iv. ≥ D5—multiorgan failure with eventual improvement or need for emergent liver transplant or death	• If possible, draw acetaminophen levels 4 h post ingestion & plot on Rumack-Matthew nomogram • N-acetylcysteine (NAC) highly protective if given within 8 h
TCAs	• Block Na^+ channels (i.e., quinidine-like effect) and serotonin reuptake • Also have anticholinergic and antihistaminic effects	• Symptoms within 6 h • Clinical diagnosis (no lab levels): nonspecific presentation with dizziness, agitation, confusion ± anticholinergic effects • ECG: long QRS, QT or PR, ± RAD of terminal 40 ms of QRS	• Supportive (fluids & inotropes) • Activated charcoal if < 2 h since ingestion • $NaHCO_3$ if ECG changes • Benzodiazepines for seizures

FOR MORE INFORMATION ON THE APPROACH TO THE POISONED PATIENT IN THE EMERGENCY DEPARTMENT

- Erickson TB, Thompson TM, Lu JJ. The approach to the patient with an unknown overdose. *Emerg Med Clin North Am*. 2007;25(2):249–281.

SKIN WOUNDS AND REGIONAL ANESTHESIA

MCC OBJECTIVE

Based on Objective #109-12 (Skin Wounds) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Irrigate, irrigate, irrigate
- Consider time since injury; mechanism, extent, and location of injury; and host factors when deciding on a closure technique
- Administer tetanus and prophylactic Abx as appropriate

APPLIED SCIENTIFIC CONCEPT

- All wounds through dermis will scar—important to communicate this to the pts and their family.

- Factors affecting wound healing and scarring:
  - Immunosuppression
  - Chronic steroid use
  - Smoking
  - Pts with Hx of keloid formation
  - Ability to keep wound clean and dry
  - Location and orientation of wound

CAUSAL CONDITIONS

- Mechanism of injury has treatment implications.
  - *Lacerations*—most amenable to immediate wound closure
  - *Crush and avulsion injuries*—tend to have extensive tissue damage and be more contaminated → higher risk of infection
  - *Punctures wounds* (see Animal and Insect Bites)
    - Assess underlying structures: damage can be more extensive than initially appreciated
    - Check for imbedded foreign body (*teeth, knife tip, needles)*

APPROACH

Hx

- Mechanism and timing of injury → can close within 12 h (24 h if on face)
- Td status

Physical Exam

- Assess underlying structures and distal neurovascular status
- Look for retained foreign bodies
- If delayed presentation: assess for signs of infection (redness, warmth, fever, purulent drainage)

Investigations

- XR for radio-opaque foreign bodies or underlying fracture
- Wound culture if delayed presentation and signs of infection

Management

6 Cs of Wound Closure

1. **Cold** (anesthesia)
   - Topical ± infiltrated local anesthetic (see Clinical Box, Maximal Dose of Local Anesthetics)
   - Slowly inject through wound margins (*not intact skin)* with 25 to 27 G needle to minimize discomfort
2. **Clean**
   - Irrigate irrigate irrigate!—Does not require sterile water: Tap water is safe
   - Clean area to be sutured with chlorhexidine or equivalent. *Do not* put in wound: causes local tissue damage
3. **Cut**
   - Debride heavily contaminated or necrotic tissue
   - Be careful in areas where debridement has limitations (e.g., face)
4. **Closure** (Table 5.14)
   - Methods of wound closure
     - Suture—good approximation and cosmetic results. Specific technique depends on depth and tension of wound (see Clinical Box, Size of Suture by Anatomical Site).
       - Deep/buried stitches should use *absorbable* suture material.
       - Superficial stitches should use nonabsorbable (silk or synthetic alternatives: monofilament synthetic suture material poses the least infection risk).
     - Staples—good for hemostasis and closure in noncosmetic locations (scalp) or for rapid closure in a trauma setting.
     - Glue/skin adhesives—fast, easy to use. Wound must be well approximated under very little tension. Areas that get wet should be avoided (e.g., around mouth).
     - Skin tape—good for well-approximated wounds under very little tension. Can be used in conjunction with glue.
5. **Cover**
   - Apply sterile dressing ± topical Abx

6. Care

- Instruct pts:
  - How to care for and change dressings
  - How to watch for signs of infection
  - When to have sutures/staples removed
- Td as appropriate (Table 5.15)

TABLE 5.14 • Types of Wound Closure

Types of Closure	Indications	Contraindications
Primary	• Immediate skin closure in wounds with low-risk infection • Within 12 h (24h for facial lacerations)	• Punctures • Bites • Extensive crush or debridement
Secondary	• Wound left open to heal by granulation & contraction • For contaminated or infected wounds • Wounds presenting outside acceptable time for 1° closure	• Cosmesis a significant concern • Unable to control bleeding
Delayed primary	• Wound initially left open, kept covered with antimicrobial mesh dressing, then closed 3–5 d later if no signs of infection • High-risk infection but significant cosmetic concern • Wounds with significant tension	• N/A

TABLE 5.15 • Appropriate Administration of Td/Tdap and Tig

Tetanus Immunization History		Clean, Minor Wounds		All Other Wounds	
		Td or Tdap	Tig	Td or Tdap	Tig
Uncertain or < 3 doses		Yes	No	Yes	Yes
≥ 3 doses	Last booster > 10 yr	Yes	No	Yes	No
	Last booster > 5 yr	No	No	Yes	No
	Last booster < 5 yr	No	No	No	No

- Prophylactic Abx
  - *No* evidence for routine use
  - *Consider* for: gunshot wounds (*esp high velocity*), +++ contaminated wounds, crush injury, host predisposition to infection (see Clinical Box, Host Factors Predisposing to Wound Infection, *note: There are no consistent consensus guidelines on Abx prophylaxis in the emergency department clinical judgment and local practice patterns determine use.)*
  - For indications in bite wounds, see Animal and Insect Bites

FOR A MORE DETAILED APPROACH TO SUTURE MATERIALS AND SUTURE TECHNIQUES

- www.practicalplasticsurgery.org; Semer NB. Suturing: the basics. In: Semer NB, ed. *Practical Plastic Surgery for Nonsurgeons*. Philadelphia, PA: Hanley & Belfus; 2001;6:57–67.

SUBMERSION INJURIES

MCC OBJECTIVE

Based on Objective #109-6 (Drowning [Near-Drowning]) of *Objectives for the Qualifying Examination,* 3rd edition.

CLINICAL box

Maximal Dose of Local Anesthetics

Lidocaine: 5 mg/kg
Lidocaine + EPI: 7 mg/kg
Bupivacaine: 2 mg/kg
Bupivacaine + EPI: 3 mg/kg

WOUNDS REQUIRING SPECIAL ATTENTION

- Heavily contaminated
- Crush injuries
- Immunocompromised host
- Injuries to tendon/nerve/blood vessels
- Underlying fractures
- Wounds over joints
- Human or animal bites (see Animal and Insect Bites)

CLINICAL box

Host Factors Predisposing to Wound Infection

Diabetes
Obesity
Malnutrition
Chronic renal disease
Advanced age
Chronic steroid use
Immunocompromised
Smoking

CLINICAL box

Size of Suture by Anatomical Site[a]

Trunk/back: 3.0 to 4.0
Scalp: 4.0
Arms/legs: 4.0 to 5.0
Hands/feet: 5.0
Face: 6.0

[a] Smaller sutures allow better cosmesis, while large sutures provide more strength. Smaller suture = bigger number (i.e., 6.0 smaller than 3.0).

OVERVIEW

- Submersion: Resp impairment as a person's airway goes below the surface of the liquid (*note: Newer nomenclature has been adopted by WHO*)
- Drowning: a process resulting in primary Resp impairment from submersion/ immersion in a liquid medium. A liquid/air interface is present at the entrance of the victim's airway, preventing the breathing of air. The victim may live or die, but whatever the outcome, he or she has been involved in a drowning incident.
- Epidemiology:
  - Third leading cause of unintentional injury death worldwide.
  - Canada and New Zealand are the only countries worldwide where adult males are at higher risk of drowning than children under 5.

APPLIED SCIENTIFIC CONCEPT

- **Natural history**: unexpected submersion → panic, breath-holding → hypoxia → begin to swallow water → eventual aspiration when unable to breath hold
- **Salt versus fresh water drowning**: This distinction is largely unfounded. Initially thought that the hypertonicity of salt water worsened pulmonary edema; however, the effects are only seen at volumes of aspiration much greater than those causing with near-drowning events.
- Dead sea submersions *can* cause ↑ Mg^{2+}, ↑ Ca^{2+} from absorption sea water (*see Injury in Review, 2012 edition*)[2]
- **Diving reflex:** can be protective in infants and children
  - Cold water to the face → apnea + bradycardia → shunting of blood to brain and heart
- **Effects of water temperature**: Cold water is both harmful and protective
  - Harms: earlier exhaustion, cardiac dysrhythmias, ↓ LOC
  - Protective: ↓ cerebral metabolism and minimize neural injury

CAUSAL CONDITIONS (Clinical Box, Drowning Risk Factors)

APPROACH

Hx

- Submersion medium and temperature
- Submersion time and time since submersion
- On-scene resuscitation efforts

Diagnosis and Management (Table 5.16)

CLINICAL box

Drowning Risk Factors

- Age: children < 5
  - Lack of supervision
  - Developmental delay
  - Seizure disorder
  - Low SES
- Teenagers (risk-taking behaviors)
- Males > females
- Unable to swim
- Drugs/alcohol
- Underlying cardiac disease
- Hypothermia/cold water

TABLE 5.16 • Effects and management of submersion injuries

System	Pathophysiology	Investigations	Treatment
CNS	• Hypoxia and acidosis → cerebral edema	• ICP monitoring in severe cases • CT head/neck only if suspect injury	• As in trauma, hypothermia (both from event and as treatment) may be neuroprotective • AHA does not recommend routine C-spine immobilization
CVS	• Hypoxia, acidosis, & hypothermia → arrhythmias	• ECG + cardiac monitors	• In cases of cardiac arrest: consider stopping CPR only after core temp > 32°C
Resp	• Aspiration washes out surfactant → pulmonary edema → ARDS • May also be a component of laryngospasm	• CXR • ABG	• Supplemental O_2 • Secure airway as necessary • PEEP
Metabolic	• Mixed Resp/metabolic acidosis • Dead sea: can cause electrolyte abnormalities	• ABG • Electrolytes	• Supportive management • Treat electrolyte abnormalities that arise
Renal	• Hypoxia + acidosis → Myoglobinuria + ATN	• BUN, Cr • Urine myoglobin • Urine lytes	• Foley to urometer • Treat Rhabdo as required

- As always begin with:
  - ABCs
    - If in cardiopulmonary arrest, perform CPR as soon as possible
  - Full set of vitals (including glucose and temperature)
  - Cardiac monitoring and pulse oximetry
- Begin rewarming if necessary (see Hypothermia Section)
- Symptomatic pts: All should be admitted
- Asymptomatic pts: observe for 6 to 8 h
  - IF O_2 sats normal on room air, CXR, ABG normal → discharge

FOR MORE INFORMATION ON DROWNING

- Szpilman D, Bierens JJLM, Handley AJ, et al. Drowning. *N Engl J Med.* 2012; 366(22):2102–2110.

FOR INFORMATION ON PEDIATRIC DROWNING

- Rose E. Denmark TK. An evidence-based approach to the evaluation and treatment of drowning and submersion injuries. *Pediatr Emerg Med Pract.* 2011;8(6):1–20.

TRAUMA

MCC OBJECTIVE

Based on Objective #109 (Trauma) of *Objectives for the Qualifying Examination,* 3^{rd} edition.

OVERVIEW

- Evaluation and treatment of all traumas should follow a standardized ABCDE approach as per ATLS guidelines. This allows for safe and efficient care, as well as effective team dynamics.

APPLIED SCIENTIFIC CONCEPT

- **Shock**
  - Tissue hypoxia and end-organ dysfunction 2° to tissue hypoperfusion (Table 5.17)
    - Most common complication of trauma. Early recognition of shock (see Clinical Box, Presentation of Hypovolemic Shock) is crucial in preventing morbidity and mortality in trauma.
    - Hypovolemic/hemorrhagic shock is the most common form of shock seen in trauma victims.
    - Complications of shock are initially reversible; however, prolonged hypoxia leads to potentially irreversible cellular biochemical dysfunction (Figure 5.12).

!

Shock

Normal BP does not mean that hemorrhagic shock is not present. Shock can initially be well compensated hemodynamically (i.e., normal BP), especially in the young.

TABLE 5.17 • Categories of shock and associated physiologic changes

	Cardiac Output	Systemic Vascular Resistance	BP	Skin
Hypovolemic	↑ (↑ HR, ↑ contractility)	↑ (vasoconstriction)	Narrow pulse pressure	Cold
Distributive	↓ (↓ Preload)	↓ (Vasodilation)	Wide pulse pressure	Warm
Cardiogenic	↓ (↓ Cardiac contractility)	↑ or normal	↓	Cold
Obstructive	↓	↑ (Veno congestion)	↓	Cold

- **Wounds**
  - See section on wound healing for full discussion.
  - In trauma, treatment focuses on minimizing blood loss with risk of infection.
  - As pt stability and time allow, consider restoration of tissue function, strength, and cosmesis.

CAUSAL CONDITIONS

- Trauma is the leading cause of death in Canadians aged 1 to 44, and the fourth leading cause of death in all ages.

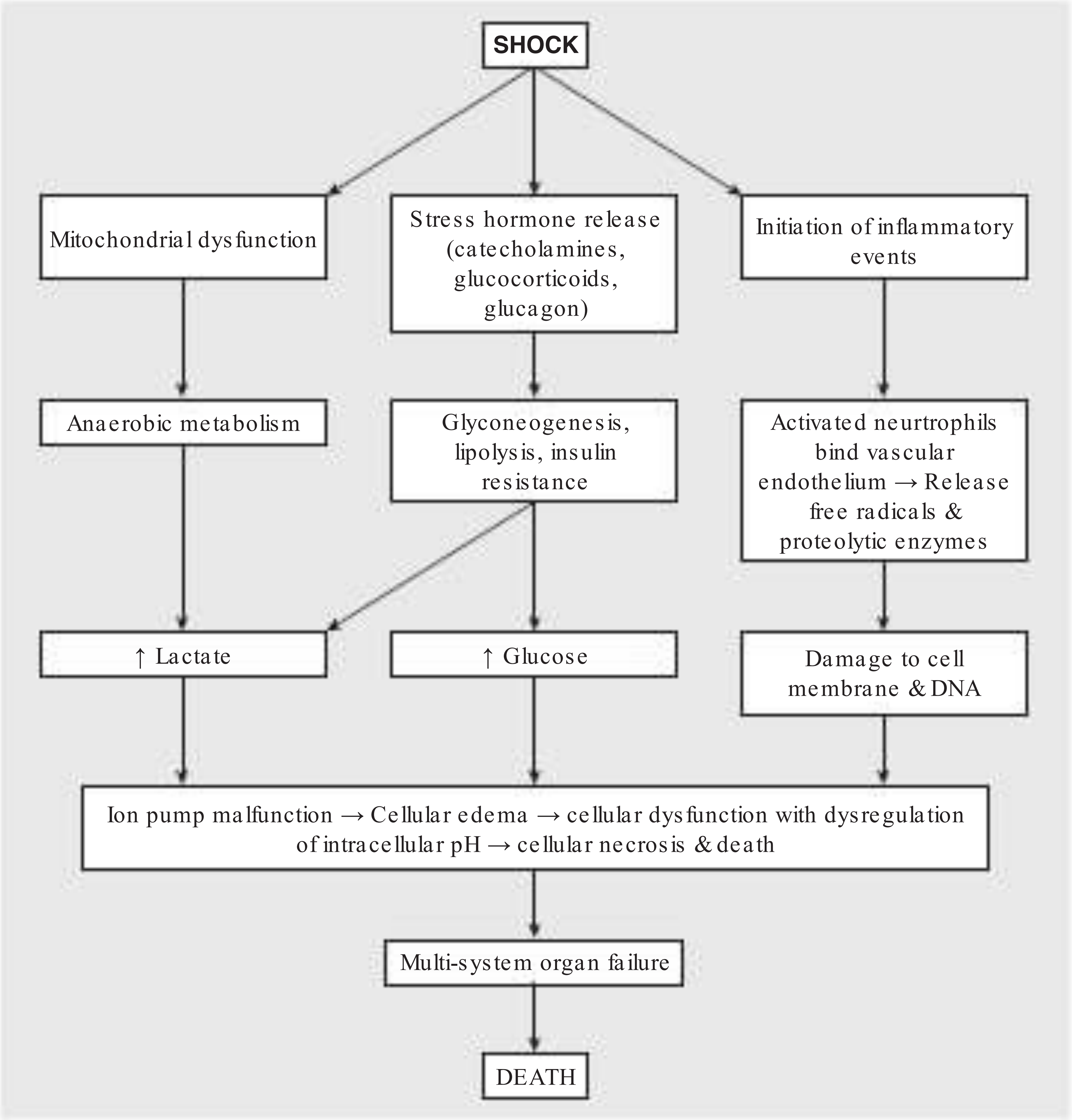

SHOCK
Mitochondrial dysfunction
Stress hormone release (catecholamines, glucocorticoids, glucagon)
Initiation of inflammatory events
Anaerobic metabolism
Glyconeogenesis, lipolysis, insulin resistance
Activated neurtrophils bind vascular endothelium → Release free radicals & proteolytic enzymes
↑ Lactate
↑ Glucose
Damage to cell membrane & DNA
Ion pump malfunction → Cellular edema → cellular dysfunction with dysregulation of intracellular pH → cellular necrosis & death
Multi-system organ failure
DEATH

Figure 5.12. Complications of shock.

- Falls are the leading cause of minor injury, MVCs are the leading cause of major injury, and penetrating trauma accounts for 4% overall.
- Alcohol factors into 25% of MVC trauma and 33% of penetrating trauma in Canada.
- Overall, trauma can be divided into blunt and penetrating causes.

CLINICAL box

Presentation of Hypovolemic Shock

- Appears unwell
- Tachycardia
- Tachypnea
- Hypotension
- Hypoxemia
- ↑ serum lactate
- ↓ U/O

APPROACH

Hx

Sample Hx

- **S**—Signs and Symptoms of injury/illness
- **A**—Allergies
- **M**—Medications
- **P**—Past medical Hx, pregnancy
- **L**—Last oral intake (including substances)
- **E**—Events surrounding the trauma

Diagnosis

Primary Survey—"ABCDEs"

- Assessment occurs in a stepwise manner unless sufficient personnel resources and experience allow for simultaneous assessments.

A: AIRWAY with C-Spine Control

- Maintain C-spine control until spinal injury can be ruled out
- Ensure no upper airway obstruction (foreign bodies, fluid, blood in oropharynx)
- R/O airway compromise from facial/tracheal injuries

- Use a Jaw-thrust maneuver along with suctioning to improve airway patency if obstructing
- Consider intubation if GCS < 8

B: Breathing

- Continuous Spo_2 monitoring and supplemental O_2
- Examine chest wall and trachea and auscultate for ventilatory compromise, evidence of unequal air entry, or tension pneumothorax

C: Circulation with Hemorrhage Control

- Two large-bore IVs
- Quickly assess circulatory status: LOC, peripheral pulses, BP, skin color, and temperature
- Hypotension is due to hemorrhage until proven otherwise
- Can include an U/S FAST exam
- Apply pressure on areas of deadly bleeding
- Align obviously fractured long bones
- Foley insertion if no contraindications

D: Disability

- Gross assessment of neurologic function
- GCS
- Pupils: size and reactivity (impending or completed cerebral herniation)
- Movement of hands and feet
- Palpate for midline spinal tenderness and assess rectal tone

E: Exposure and Environmental Control

- Completely expose all body areas, including log roll
- Rapidly examine for gross deformities, bleeding, or life-threatening injury
- Whenever possible, cover pt with warm blankets/external warming devices
- Prevent hypothermia from developing or worsening

Secondary Survey (Table 5.18)

- Begins once resuscitation measures underway and vitals are stabilizing
- A more thorough systems-based assessment

PNEUMOTHROAx

Positive pressure ventilation can rapidly turn a pneumothroax into a tension pneumothorax

CLINICAL box

Areas Where Significant Bleeding Can Occur

- Chest
- Abdomen
- Pelvis (3 L)
- Thigh (1 L each)
- Retroperitoneal space
- Street (i.e., from large lacerations, esp scalp)

CLINICAL box

Deadly Dozen Chest Injuries

Immediately Life Threatening

- Tension pneumothorax
- Open pneumothorax or chest wound
- Pericardial tamponade
- Flail chest
- Massive hemothorax
- Airway obstruction

Potentially Life Threatening

- Aortic injury
- Tracheobronchial injury
- Blunt cardiac injury
- Diaphragmatic rupture
- Esophageal rupture
- Pulmonary contusion

TAbLE 5.18 • Secondary survey

Head	Look for lacerations, contusions, and fractures Palpate skull and facial bones Test cranial nerves Test for malocclusion
EENT	Visual acuity & extraocular movements, remove contact lenses Ottoscopy: intact, blood, or CSF Signs of basal skull # (hemotympanum, CSF rhinorrhea, raccoon eyes, battle sign)
Chest	Palpate chest wall, including clavicles & ribs Feel for subcutaneous emphysema, tracheal deviation, flail segments
CVS	Heart sounds, JVP, bilateral BPs Palpate peripheral pulses
Abdo	Inspect for ecchymosis Palpate for guarding, peritonitis
Neuro	Gross assessment for sensation, motor, and reflexes in all 4 limbs
GU	Assess for urethral trauma, genital injury, rectal bleeding
Extremities	Palpate all long bones and assess joints

Investigations

- *Blood work*: CBC, type and screen, INR/PTT, lytes, BUN, Cr, B-HCG (females), lactate
  - Consider: ABG/VBG, lipase, LFTs, toxicological workup
- *Studies*: CXR, pelvic XR, C-spine films (considering Canadian C-spine rules)
  - XR suspected injuries
  - CT scans of the chest, abdo, pelvis, and spines as appropriate

  - Other tests one can consider, depending on resources available and training, are FAST U/S and DPL

Management

- Dependent on hemodynamic stability, injury severity, and need for specialist services
  - Observe in ED, admit to ICU/trauma service, or transfer to trauma service
  - If transferring to a higher level of care consider:
    - Method of transport (ground vs. air)
    - Skill of providers (Is a physician required for transport?)
    - Equipment that will be available
    - Potential for decompensation (difficult in intubate or insert chest tube in the back of an ambulance)

FOR AN OVERVIEW ON THE APPROACH TO TRAUMA PATIENTS

- Committee on Trauma, American College of Surgeons. *Advanced Trauma Life Support for Doctors (ATLS), Student Course Manual.* 8th ed. Chicago, IL: American College of Surgeons; 2008.

IMAGING

An unstable pt should not be sent for CT scan

Unstable + obvious peritonitis → direct to OR for laparotomy

CLINICAL box

Indications to Transfer to Higher Level of Care

- Require specialized imaging (e.g., CT scan)
- Require specialized services (e.g., surgery)
- Require close monitoring in ICU setting

SUGGESTED READINGS

Canadian Institute for Health Information. *National Trauma Registry 2011 Report: Hospitalizations for Major Injury in Canada.* Ottawa, ON: Canadian Institute for Health Information; 2011. https://secure.cihi.ca/estore/productSeries.htm?pc= PCC46

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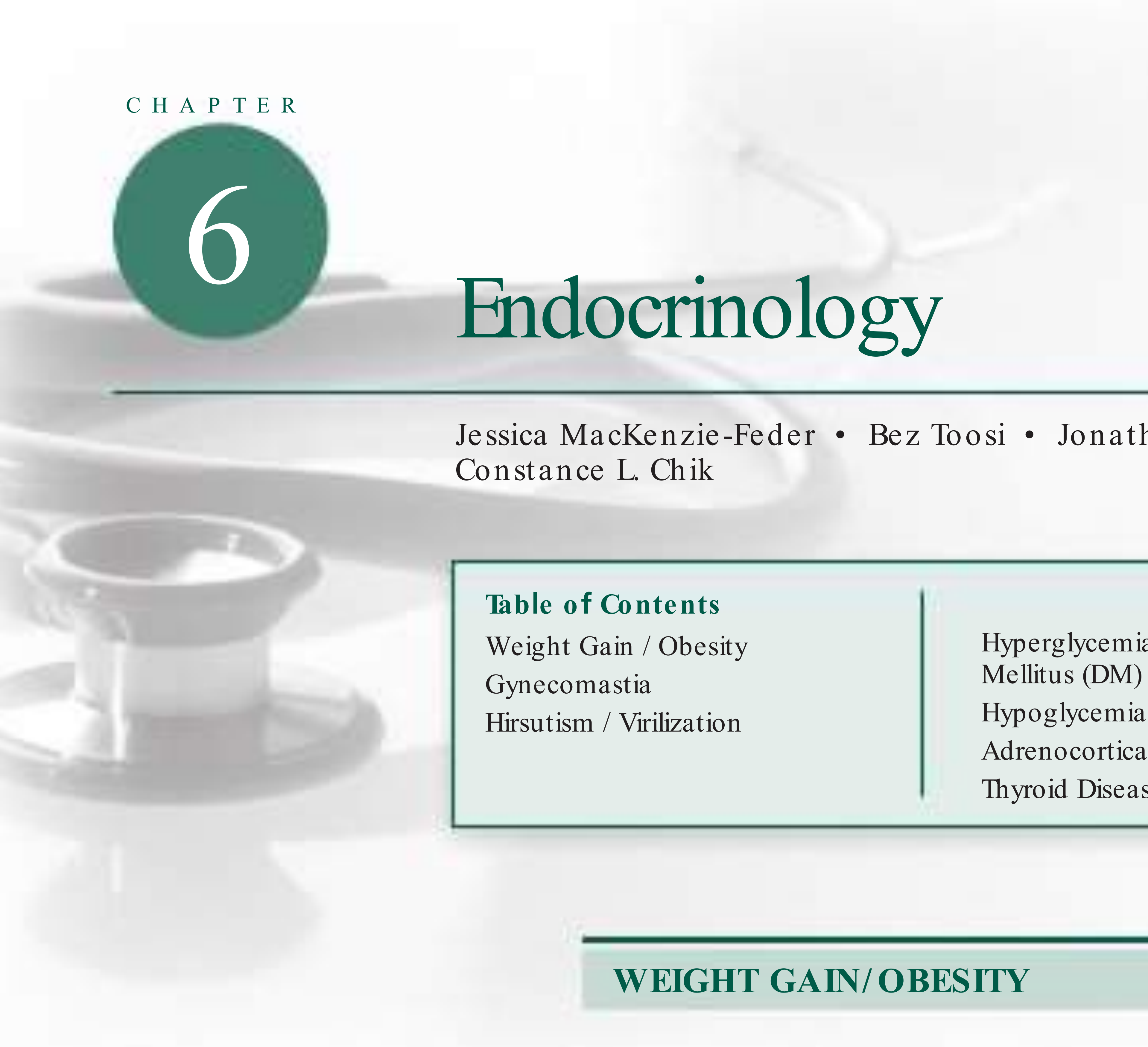

CHAPTER

6

Endocrinology

Jessica MacKenzie-Feder • Bez Toosi • Jonathan Cena • Donald W. Morrish • Constance L. Chik

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Weight Gain / Obesity
Gynecomastia
Hirsutism / Virilization
Hyperglycemia: Diabetes Mellitus (DM)
Hypoglycemia
Adrenocortical Insuffiency (AI)
Thyroid Disease

WEIGHT GAIN/OBESITY

MCC OBJECTIVE

Based on Objective #118-1 (Weight Gain, Obesity) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Over 68% of US adults are overweight or obese (BMI > 30 kg/m^2), with an increasing prevalence in the world. Obesity is associated with multiple health problems.

APPLIED SCIENTIFIC CONCEPTS

Obesity occurs when energy intake exceeds energy expenditure from resting metabolic rate, storing food, exercise, and adaptive thermogenesis (Figure 6.1). The pathogenesis of common obesity has not been established.

The fat cell releases multiple hormones that affect appetite and energy metabolism (Figure 6.2). Very rare genetic syndromes with mutations in proopiomelanocortin, prohormone convertase-1 processing enzyme, leptin, agouti-related peptide, and other genes have been described. Several rare genetic syndromes in childhood including Prader-Willi syndrome cause obesity. Specific diseases including Cushing syndrome, hypothyroidism, insulinoma, and craniopharyngioma as well as lesions involving the hypothalamus may cause obesity.

CAUSAL CONDITIONS (Table 6.1)

APPROACH

History

- Determine if clinical symptoms and signs of endogenous causes of obesity are present (see Table 6.1)
- Determine exogenous factors contributing to obesity
- Determine if comorbid factors are present (hypertension, DM, dyslipidemia, sleep apnea, hirsutism/ovulatory dysfunction)
- Determine the risk level to a patient's health due to obesity degree and comorbid factors
- Determine the patients' goals and expectations and if they are motivated to start a weight loss program

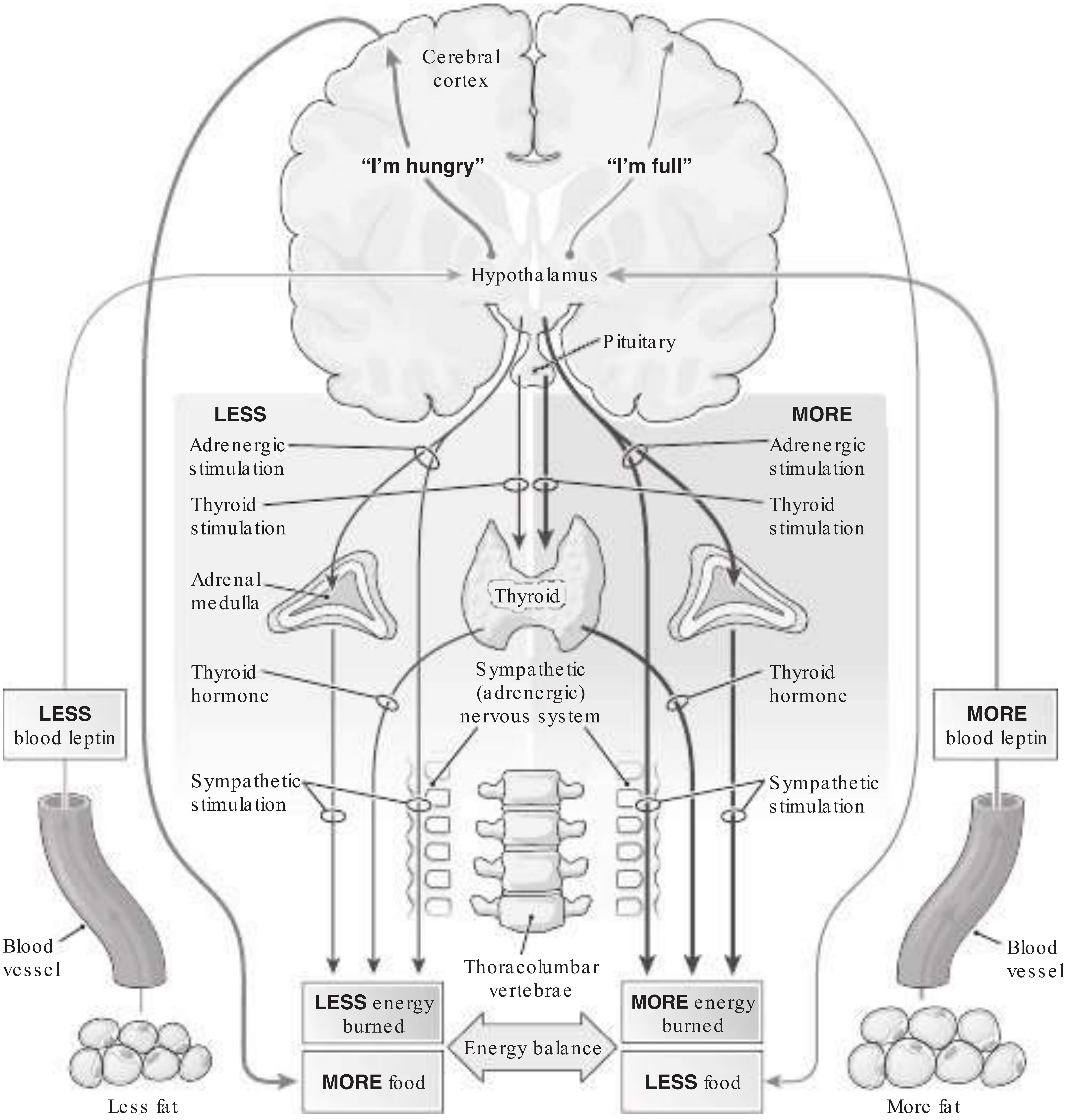


Figure 6.1. The regulation of weight and energy balance.
(From McConnell TH. *The Nature of Disease Pathology for the Health Professions*. Philadelphia, PA: Lippincott Williams & Wilkins; 2007.)

physical Exam

- Determine waist circumference (see Clinical Box, Definition of Central Obesity). Central or abdominal obesity when clustered with other CVS risk factors including hypertension, dyslipidemia, and abnormal glucose intolerance, correlates with increased risk of CVS morbidity and mortality and developing DM (Metabolic Syndrome—see Table 6.2)
- Determine signs of comorbid conditions
- Determine signs of endogenous causes

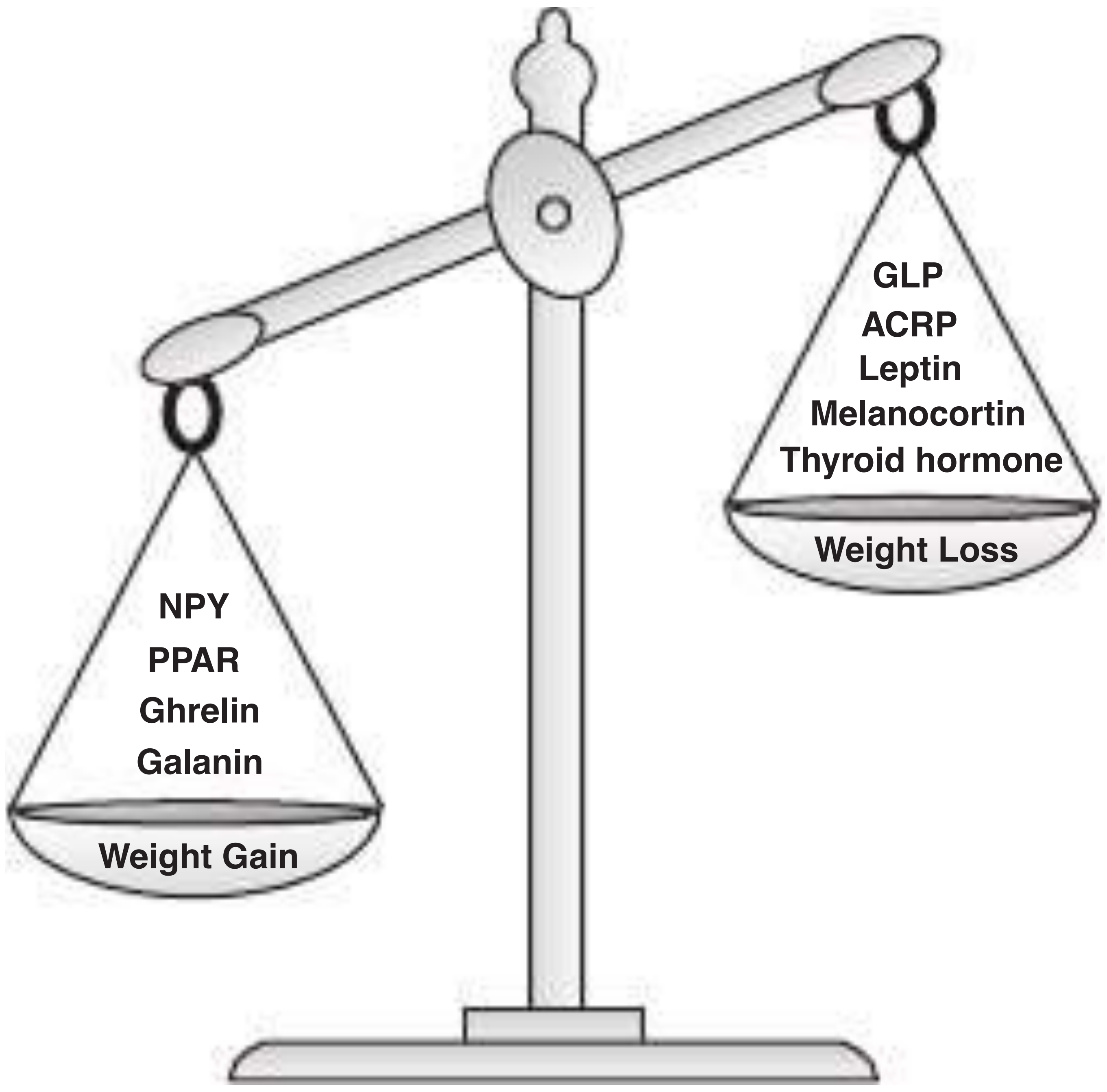


Figure 6.2. The balance of chemical mediators that promote fat accumulation (weight gain) and those that promote fat loss (weight loss). ACRP, adipocyte complement-related protein; GLP, glucagon-like peptide; NPY, neuropeptide Y; PPAR, peroxisome proliferator-activated receptor.
(From Rubin R, Strayer DS, Rubin E. *Rubin's Pathology: Clinicopathologic Foundations of Medicine*. 6th ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2011.)

TABLE 6.1 • Differential diagnosis of obesity

Mechanism	Differential Diagnosis
Exogenous	
↑ Energy intake	Overeating, frequent eating, high-fat diet
Dietary	Socioeconomic, cultural, psychological
Social, behavioral	Drugs, hormones, hypothalamic surgery
Iatrogenic	Sedentary lifestyle, smoking cessation
↓ Energy expenditure	
Endogenous	
Neuroendocrine	Growth factor deficiency Cushing syndrome Hypothyroidism PCOS Obstructive sleep apnea Hypogonadism
Genetic	Dysmorphic syndrome (e.g., Prader-Willi syndrome) Defects in genes modulating obesity (e.g., neuropeptide Y, POMC) Family history of obesity

TABLE 6.2 • International Diabetes Federation worldwide consensus definition of the MetSyn

Central Obesity[a,b] and Two or More of the Following			
HTg[c]		$\geq$ 1.7 mmol/L	**Or** treatment for this lipid abnormality
Low HDL	**Male**	< 1.03 mmol/L	**Or** treatment for this lipid abnormality
	Female	< 1.29 mmol/L	
Hypertension		Systolic BP $\geq$ 130 or Diastolic BP $\geq$ 85 mm Hg	**Or** treatment for this condition
Elevated FPG		$\geq$ 5.6 mmol/L	**Or** previously diagnosed DM

[a] Waist circumference does not need to be measured if BMI > 30 kg/m^2 as central obesity can be assumed.

[b] Definition of central obesity varies depending on ethnicity.

[c] HTg, elevated triglyceride.

CLINICAL box

Definition of Central Obesity[a]

Waist Circumference (cm)		
All ethnicities except those listed below	Male	$\geq$ 94
	Female	$\geq$ 80
Chinese, Japanese, South Asians[b]	Male	$\geq$ 90
	Female	$\geq$ 80

[a] International Diabetes Federation definition. Please note country-specific cut-points for elevated waist circumference. In the United States/Canada, categorical cut-points for male $\geq$ 102 cm and female $\geq$ 88 cm.

[b] South Asians: based on a Chinese, Malay, Asian-Indian population.

Investigations (Figure 6.3)

- The diagnostic goal is to determine secondary causes of obesity and comorbidities (see Table 6.1).
- Rapid onset accompanied by other symptoms is highly suspicious for pathologic or drug causes.

Management

- Obesity is a chronic condition requiring multidisciplinary approach.
- Management is focused on dietary habits, physical activity, and lifestyle modification. Patients should consult a dietitian for calorie targets and type of diet. Physical activity should be incorporated into daily routine.
- Drug therapy can be considered if lifestyle modifications are ineffective. Orlistat, a lipase inhibitor, produces 9% to 10% weight loss.
- Bariatric surgery can be considered for severely obese patients (BMI $\geq$ 40 kg/m^2) and includes gastric banding, Roux-en-Y gastric bypass, and sleeve gastrectomy.
- Screening and follow-up of comorbidities should be performed regularly.

GYNECOMASTIA

MCC OBJECTIVE

Based on Objective #10-3 (Gynecomastia) of the *Objectives for the Qualifying Examination*, 3rd edition.

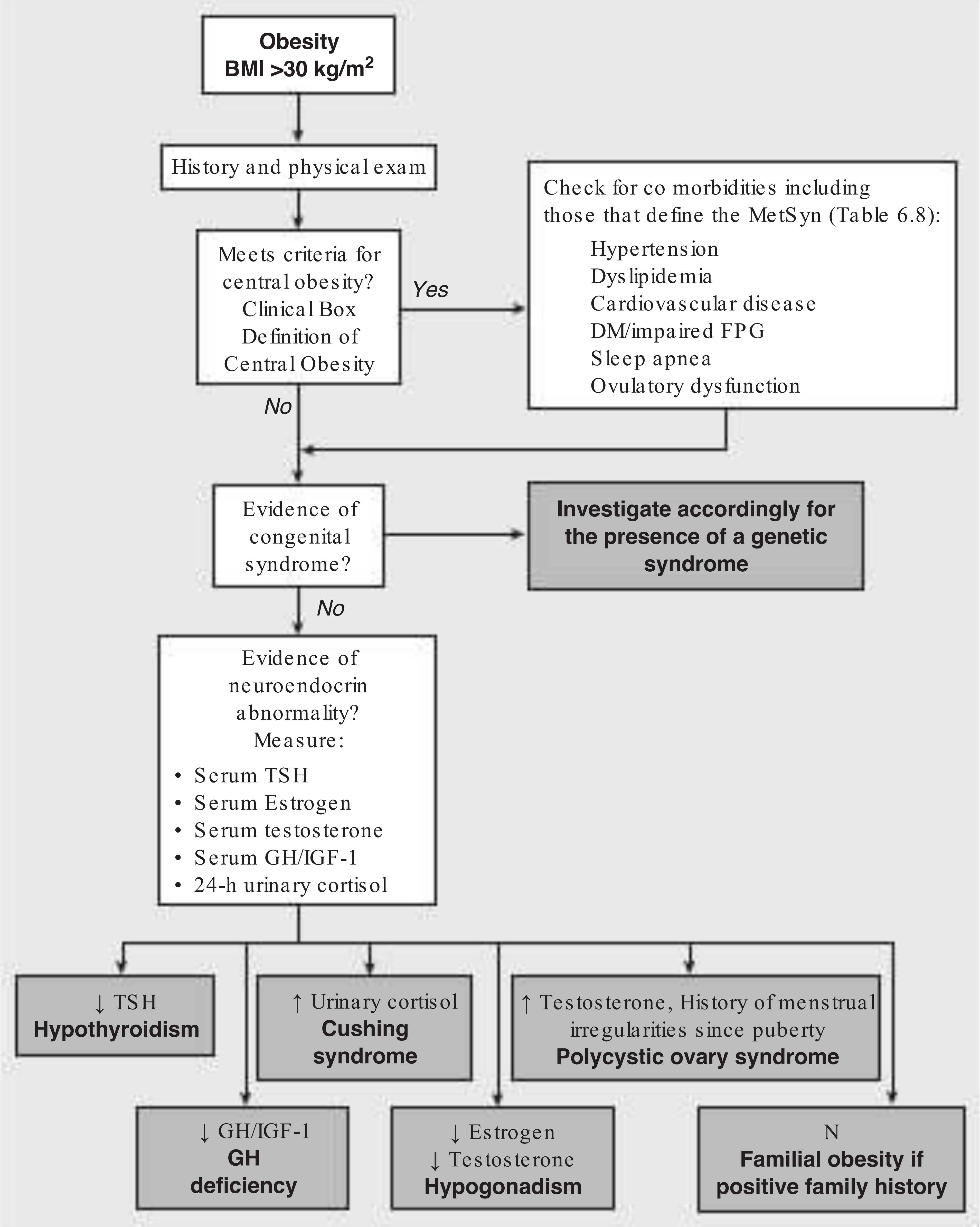

Obesity
BMI >30 kg/m²
History and physical exam
Meets criteria for central obesity? Clinical Box Definition of Central Obesity
Yes
Check for co morbidities including those that define the MetSyn (Table 6.8):
Hypertension
Dyslipidemia
Cardiovascular disease
DM/impaired FPG
Sleep apnea
Ovulatory dysfunction
No
Evidence of congenital syndrome?
Investigate accordingly for the presence of a genetic syndrome
No
Evidence of neuroendocrin abnormality? Measure:
• Serum TSH
• Serum Estrogen
• Serum testosterone
• Serum GH/IGF-1
• 24-h urinary cortisol
↓ TSH
Hypothyroidism
↑ Urinary cortisol
Cushing syndrome
↑ Testosterone, History of menstrual irregularities since puberty
Polycystic ovary syndrome
↓ GH/IGF-1
GH deficiency
↓ Estrogen
↓ Testosterone
Hypogonadism
N
Familial obesity if positive family history

Figure 6.3. Approach to diagnosing the cause of obesity.

OVERVIEW

- Gynecomastia is enlargement of the male breast.

APPLIED SCIENTIFIC CONCEPTS

- Gynecomastia is a result of an increased estrogen/androgen ratio.
- Increase in estrogen, decrease in androgen, or both can result in gynecomastia.
- Estrogen stimulates proliferation of breast tissue.

CAUSAL CONDITIONS (Table 6.3)

APPROACH

History

- Gynecomastia must be distinguished from male breast cancer.
- Determine if drug ingestion, symptoms of sexual dysfunction (poor libido, erectile dysfunction), hypogonadism (failed male pubertal development; decrease in secondary sex characteristics postpuberty), symptoms of renal/liver failure, or hyperthyroidism are present.

TABLE 6.3 • Differential diagnosis of gynecomastia

Mechanism	Differential Diagnosis
Physiologic gynecomastia	Gynecomastia of the newborn Pubertal gynecomastia Gynecomastia of aging
Pathologic gynecomastia Deficient testosterone production or action	
Primary gonadal (testicular) failure Androgen insensitivity syndrome Secondary gonadal (hypothalamus/pituitary) failure	**Genetic**: Klinefelter syndrome, enzymatic defects in testosterone synthesis **Acquired**: infection/viral orchitis, trauma, renal failure
↑ Estrogen or estrogen precursors	
↑ Testicular estrogen secretion ↑ Substrate for extraglandular estrogen formation ↑ Activity of extraglandular aromatase	Testicular tumors, hCG-producing tumors, true Adrenal carcinomas, liver disease, hyperthyroidism
Drugs	
Estrogen, estrogen mimetics Drugs enhancing endogenous estrogen production Inhibitors of testosterone synthesis or action Unknown mechanism	Prostate cancer treatments (e.g., flutamide), anabolic steroids hCG, clomiphene citrate Antifungals (imidazoles), antineoplastic agents, antiandrogens, spironolactone Captopril, amiodarone, methyldopa, methotrexate, isoniazid, tricyclic antidepressants, street drugs (amphetamines, heroin), alcohol
Idiopathic gynecomastia	

- Determine when gynecomastia started. Pubertal gynecomastia can persist into adulthood.

Physical Exam

- Gynecomastia must be distinguished from adipose tissue.
- Gynecomastia is abnormal except for the three physiologic conditions listed in Table 6.3.
- Determine presence of male secondary sex characteristics, including testicular size.

Investigation (Figure 6.4)

- All patients should have serum testosterone, estradiol, LH, hCG, prolactin, creatinine, TSH, and liver function tests.
- Gynecomastia is common in adolescence (up to 64%) and in adults aged 65 or older, particularly with weight gain.

Management

- Underlying secondary disorders should be treated.
- Gynecomastia tissue often does not adequately regress after treatment of underlying disorder and may require surgical removal. Drug therapy with antiestrogens or aromatase inhibitors has little efficacy.

HIRSUTISM/VIRILIZATION

MCC OBJECTIVE

Based on Objective #43 (Hirsutism, Hypertrichosis) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Hirsutism is defined as male-pattern growth of terminal hair in females, affecting 10% of the female population. It is most commonly idiopathic or caused by polycystic ovarian syndrome. Other clinical evidence for PCOS includes menstrual irregularity, infertility, and acne. *Virilization* refers to a state with sufficiently high androgen levels to produce androgenic alopecia, voice deepening, loss of female body contours, muscle growth, and clitoromegaly and suggests the presence of an adrenal or ovarian neoplasm.

Hirsutism should be distinguished from hypertrichosis, a generalized increase in growth of vellus hair (fine, nonpigmented) in a nonsexual pattern.

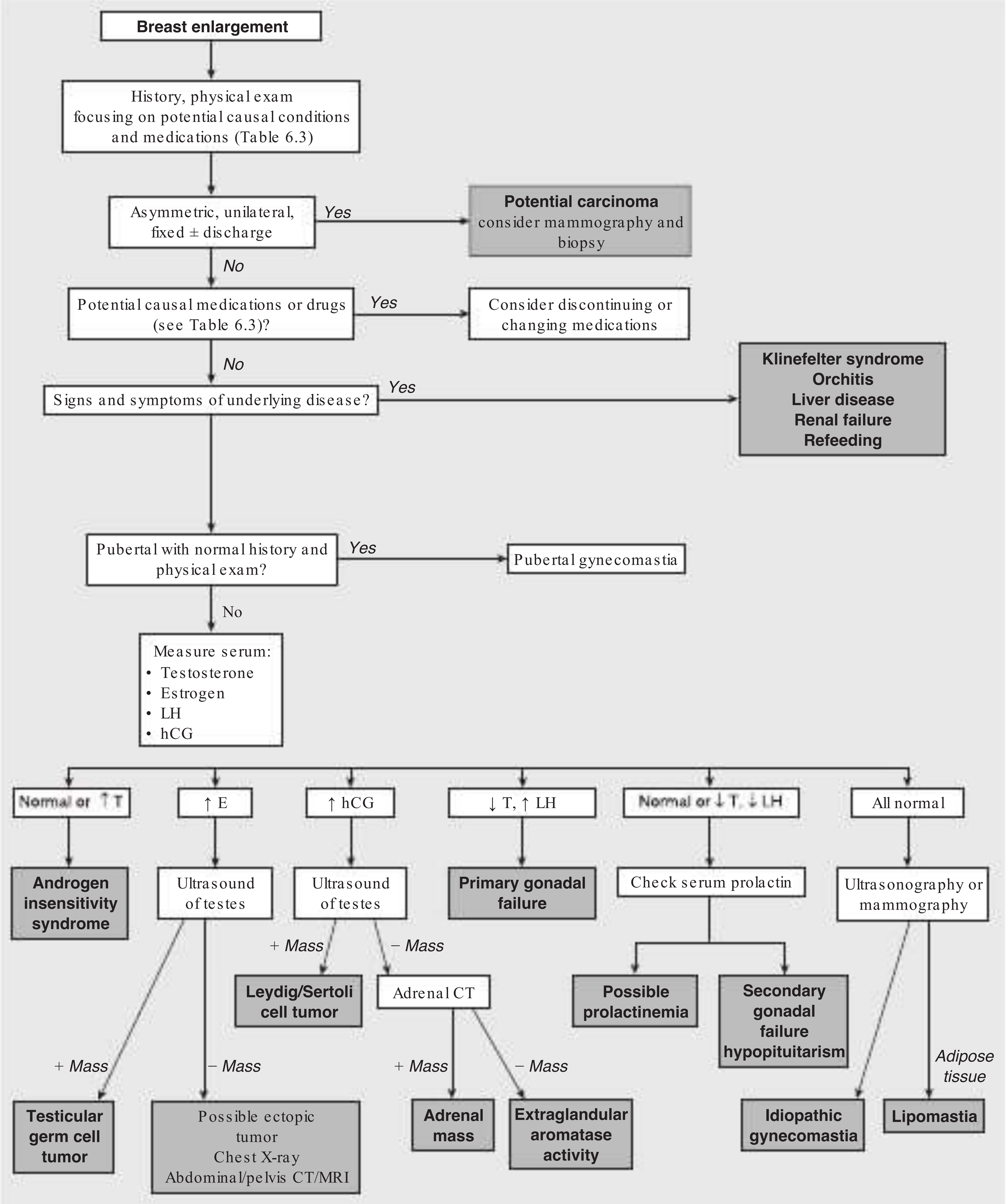

Breast enlargement
History, physical exam focusing on potential causal conditions and medications (Table 6.3)
Asymmetric, unilateral, fixed ± discharge
Yes
Potential carcinoma consider mammography and biopsy
No
Potential causal medications or drugs (see Table 6.3)?
Yes
Consider discontinuing or changing medications
No
Signs and symptoms of underlying disease?
Yes
Klinefelter syndrome
Orchitis
Liver disease
Renal failure
Refeeding
Pubertal with normal history and physical exam?
Yes
Pubertal gynecomastia
No
Measure serum:
• Testosterone
• Estrogen
• LH
• hCG
Normal or ↑T
↑ E
↑ hCG
↓ T, ↑ LH
Normal or ↓T, ↓LH
All normal
Androgen insensitivity syndrome
Ultrasound of testes
Ultrasound of testes
Primary gonadal failure
Check serum prolactin
Ultrasonography or mammography
+ Mass
− Mass
Leydig/Sertoli cell tumor
Adrenal CT
Possible prolactinemia
Secondary gonadal failure hypopituitarism
+ Mass
− Mass
+ Mass
− Mass
Adipose tissue
Testicular germ cell tumor
Possible ectopic tumor Chest X-ray Abdominal/pelvis CT/MRI
Adrenal mass
Extraglandular aromatase activity
Idiopathic gynecomastia
Lipomastia

Figure 6.4. Approach to investigating gynecomastia.

APPLIED SCIENTIFIC CONCEPTS

Hirsutism is often caused by excess androgen, but genetic and ethnic factors influence hair growth. Androgen sources are most commonly the ovary but can also be from the adrenal gland.

CAUSAL CONDITIONS (Table 6.4)

TABLE 6.4 • Differential diagnosis of ↑ body hair

Mechanism	Differential Diagnosis
Hirsutism Androgen excess	
Ovarian source	PCOS, idiopathic, ovarian tumor
Adrenal source	Adrenal hyperplasia, Cushing syndrome, adrenal tumor, glucocorticoid resistance
Drugs	Danazol, norgestrel-ethinyl estradiol
Other	Hyperprolactinemia
Hypertrichosis	Idiopathic Drugs (e.g., phenytoin, minoxidil, cyclosporine) Systemic illness/conditions (e.g., hypothyroidism, malnutrition, malignancy, dermatomyositis, hyperprolactinemia)

APPROACH (Figure 6.5)

History

- Hirsutism is the most common presenting symptom of hyperandrogenism.
- PCOS is the most common cause of hirsutism. Other endocrine causes should be excluded.
- Rapid virilization (< 6 mo) is suggestive of adrenal or ovarian neoplasm.
- Determine drug history.

Physical Exam

- Determine male hair pattern, androgenic alopecia, voice deepening, loss of female body contours, and clitoromegaly
- Determine signs of Cushing syndrome

Investigations (see Figure 6.5)

- Initial testing should include serum testosterone and DHEAS. Twenty-four-hour urinary cortisol should be done if Cushing syndrome is suspected. Increased DHEAS usually indicates an adrenal androgen source, but can be modestly elevated in PCOS. Subsequent 17-hydroxyprogesterone levels should be done to determine if heterozygous 21-hydroxylase deficiency is present.
- Very high androgen levels (testosterone > 7 nmol/L, DHEAS > 18 μg/L) are suggestive of an adrenal or ovarian tumor, and imaging with CT or MR is needed.

Diagnosis (see Figure 6.5)

- Polycystic ovarian disease is the most common cause of hirsutism, and most patients have mild hyperandrogenism.

Management

- Treat identifiable cause, (eg., Cushing syndrome, androgen-producing tumor).
- Drug treatments include oral contraceptives, spironolactone, cyproterone acetate, flutamide, 5-a reductase type 1 inhibitors, and eflornithine (Vaniqa). Corticosteroids can be used for 21-hydroxylase enzyme defects.
- Because drug effects are limited, most patients will require other cosmetic treatments with electrolysis, laser, and other cosmetic measures.

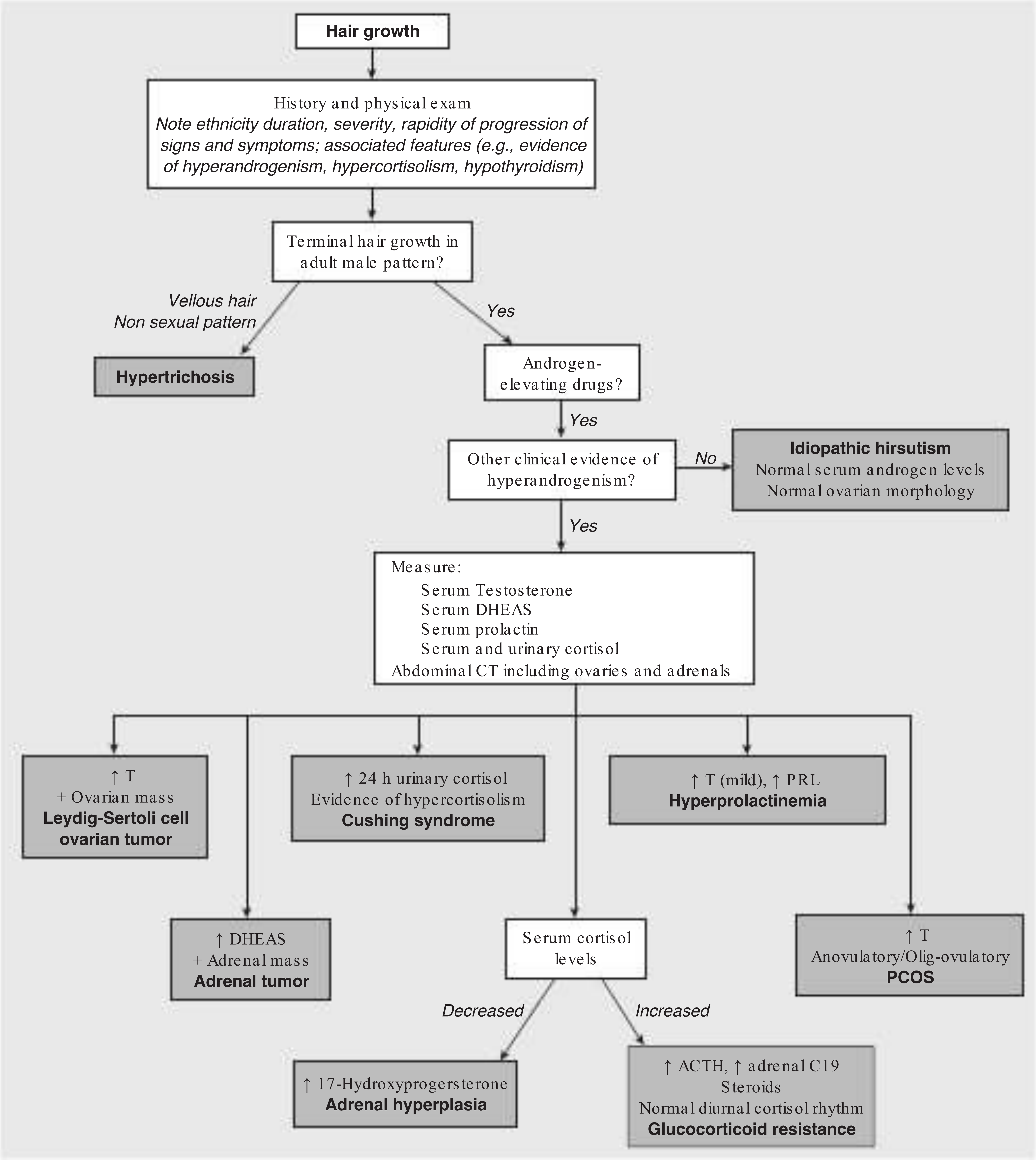

Hair growth
History and physical exam
Note ethnicity duration, severity, rapidity of progression of signs and symptoms; associated features (e.g., evidence of hyperandrogenism, hypercortisolism, hypothyroidism)
Terminal hair growth in adult male pattern?
Vellous hair
Non sexual pattern
Hypertrichosis
Yes
Androgen-elevating drugs?
Yes
Other clinical evidence of hyperandrogenism?
No
Idiopathic hirsutism
Normal serum androgen levels
Normal ovarian morphology
Yes
Measure:
Serum Testosterone
Serum DHEAS
Serum prolactin
Serum and urinary cortisol
Abdominal CT including ovaries and adrenals
↑ T
+ Ovarian mass
Leydig-Sertoli cell ovarian tumor
↑ 24 h urinary cortisol
Evidence of hypercortisolism
Cushing syndrome
↑ T (mild), ↑ PRL
Hyperprolactinemia
↑ DHEAS
+ Adrenal mass
Adrenal tumor
Serum cortisol levels
↑ T
Anovulatory/Olig-ovulatory
PCOS
Decreased
Increased
↑ 17-Hydroxyprogersterone
Adrenal hyperplasia
↑ ACTH, ↑ adrenal C19 Steroids
Normal diurnal cortisol rhythm
Glucocorticoid resistance

Figure 6.5. Approach to investigating hirsutism.

Hyperglycemia: Diabetes mellitus (Dm)

mcc Objective

Based on Objectives #37-1 (Glucose Abnormalities) and #37-2 (Diabetes Mellitus) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

DM is a syndrome of disordered metabolism with inappropriate hyperglycemia due to an absolute or relative deficiency of insulin. There may also be a defect in insulin action (insulin resistance).

APPLIED SCIENTIFIC CONCEPTS

- In type 1 DM, an absolute insulin deficiency exists due to destruction of the pancreatic b-cells.
- In type 2 DM, there is a relative insulin deficiency—circulating levels are insufficient to overcome the degree of peripheral resistance.
- In gestational DM, the first recognition of glucose intolerance occurs in pregnancy.

Symptoms of DM

- **Type 1:** symptoms of hyperglycemia and hyperketonemia predominate: glucose diuresis, enuresis, polyuria, thirst, blurred vision, weight loss, dizziness/weakness (from low plasma volume), DKA (see later).
- **Type 2:** can have features of type 1 (see above). More commonly asymptomatic. May present with complications: proteinuria, retinopathy, neuropathy, chronic infections, and foot ulcers.

CLINICAL box

Risk Factors for DM2

- Age ≥ 40 yr
- First-degree relative with type 2 diabetes
- Member of high-risk population (e.g., Aboriginal, Hispanic, South Asian, Asian or African descent)
- History of prediabetes (IGT or IFG or HbA$_{1c}$ 6.0%–6.4%)
- Presence of complications associated with diabetes
- Micro- or macrovascular disease (coronary, cerebrovascular, or peripheral)
- History of gestational DM
- History of delivery of a macrosomic infant
- Presence of vascular risk factors (hypertension, dyslipidemia, overweight, abdominal obesity)
- Presence of associated disease (polycystic ovary syndrome, acanthosis nigricans, psychiatric disorders, HIV, OSA)
- Use of drugs associated with diabetes (corticosteroids, atypical antipsychotics, HAART)

APPROACH

Diagnosis

If any of the following and patient is **symptomatic** (polyuria, polydipsia, unexplained weight loss):

- FBG $\geq$ 7.0 mmol/L
- HbA$_{1c}$ $\geq$ 6.5%
- 2-h plasma glucose in 75 g OGTT $\geq$ 11.1 mmol/L
- Random plasma glucose $\geq$ 11.1 mmol/L
  - If FBG, HbA$_{1c}$, or 2-h plasma glucose is positive **without** symptoms, repeat same test on a different day to confirm.
  - If random plasma glucose test is positive **without** symptoms, use FBG, HbA$_{1c}$ or 2-h plasma glucose OGTT to confirm.

Screening

Screening (Based on 2013 Canadian Diabetes Guidelines)

- Screening for type 2 diabetes (of asymptomatic individuals) is recommended every 3 yr starting at **age 40** (Grade D consensus).
- Screen with FPG and/or HbA$_{1c}$:
  - Normal = FPG < 5.6 mmol/L and/or HbA$_{1c}$ < 5.5%
  - Diabetes = FPG $\geq$ 7.0 mmol/L and/or HbA$_{1c}$ $\geq$ 6.5%
  - At risk and prediabetes (Figure 6.6)
- Screening at younger age is recommended if risk factors exist.

CLINICAL box

Hemoglobin A$_{1c}$

HbA$_{1c}$ reflects average blood glucose levels over 2 to 3 mo and is used routinely to monitor glycemic control in known diabetic patients. It has recently been approved by the CDA as a diagnostic test for diabetes at a threshold level of 6.5%.

- Screening for gestational diabetes (with OGTT) is routine at 25 to 28 wk of gestation or in first trimester if risk factors exist.
- Screening for type 1 diabetes is **not** recommended. Testing for DM1 is performed if symptoms of hyperglycemia exist.

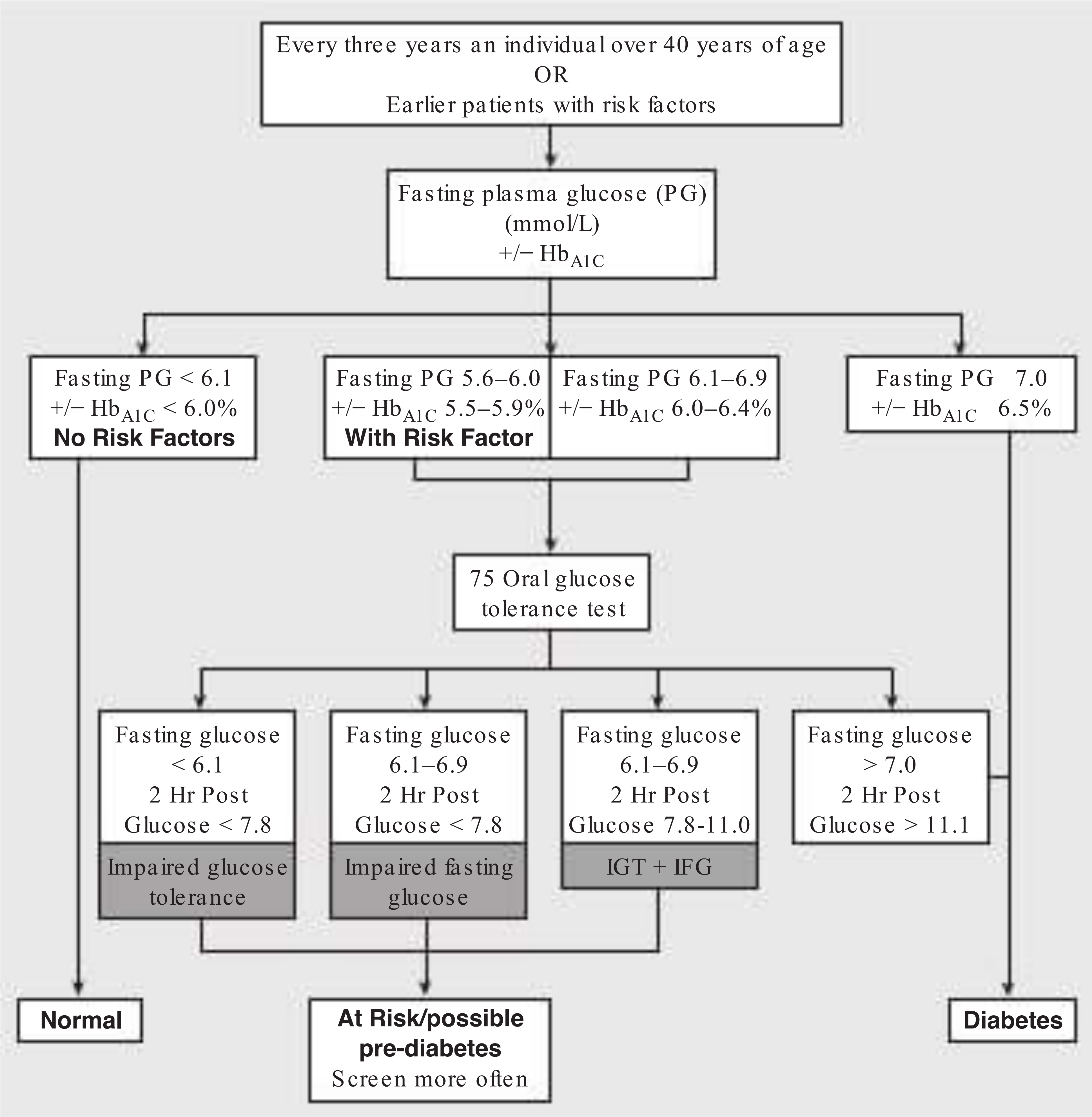

Every three years an individual over 40 years of age
OR
Earlier patients with risk factors
Fasting plasma glucose (PG) (mmol/L) +/− Hb_{A1C}
Fasting PG < 6.1 +/− Hb_{A1C} < 6.0%
No Risk Factors
Fasting PG 5.6–6.0 +/− Hb_{A1C} 5.5–5.9%
With Risk Factor
Fasting PG 6.1–6.9 +/− Hb_{A1C} 6.0–6.4%
Fasting PG 7.0 +/− Hb_{A1C} 6.5%
75 Oral glucose tolerance test
Fasting glucose < 6.1 2 Hr Post Glucose < 7.8
Impaired glucose tolerance
Fasting glucose 6.1–6.9 2 Hr Post Glucose < 7.8
Impaired fasting glucose
Fasting glucose 6.1–6.9 2 Hr Post Glucose 7.8-11.0
IGT + IFG
Fasting glucose > 7.0 2 Hr Post Glucose > 11.1
Normal
At Risk/possible pre-diabetes
Screen more often
Diabetes

Figure 6.6. Screening for type 2 diabetes in adults.

Management and Investigations

Type 1 DM, Type 2 DM, and GDM

- Complete history and physical exam to assess for complications of diabetes, additional risk factors, comorbid disease. Social history and social support network critical to future management decisions.
- Patient self-management training and education regarding hypoglycemia, screening for complications, lifestyle intervention with diet and physical activity.
- Multidisciplinary approach ideal.
- Diet: Different for type 1 (need to count carbohydrate to match insulin dose) and type 2. Balanced, high-fiber, low-saturated-fat diet is recommended. Dietitian should be involved.
- Glycemic monitoring:
  - Daily: Capillary blood samples using glucose meters most commonly used. Continuous glucose sensors also available. Essential for all patients on insulin or on medications predisposing to hypoglycemia. Useful for glycemic pattern recognition in all patients with diabetes.
  - HbA_{1c} measures glycosylation of RBCs and correlates to 2 to 3 mo of glycemic control. Alteration in RBC life span, RBC dyscrasias, and transfusions can affect reliability of assay.

- Glycemic targets in usual outpatient setting*:
  - Fasting blood glucose 4 to 7 mmol/L
  - 2-h postmeal glucose 5 to 10 mmol/L
  - $HbA_{1c} \leq 7\%$
- Specific medical therapy:
  - **Type 1 diabetes:** all require replacement therapy with exogenous insulin.
    - Usual insulin dosing: 0.2 to 0.7 unit/kg/d (but highly variable and depends on individual, carbohydrate intake, exercise, etc.).
    - Require basal insulin and prandial (meal-time) insulin: most physiologic: MDI consisting of background intermediate- to long-acting insulin plus rapid/short-acting insulin with meals OR insulin pump (Table 6.5).

TABLE 6.5 • Insulin therapy

Types of Insulin	Examples	Onset of Action	Effective Duration
Rapid acting	Lispro, aspart, glulisine	10–15 min	3–5 h
Short acting	Regular	30–60 min	6–8 h
Intermediate acting	NPH	1–3 h	Up to 18 h
Long acting	Glargine, detemir	1–1.5 h	16 (detemir) to 24 (glargine) h

  - **Type 2 diabetes:** if lifestyle interventions are not adequate to reverse hyperglycemia, medications are available for treatment of type 2 diabetes. If glycemic control is not achieved with oral agents (see Table 6.6) and/or if insulin deficiency is the predominant problem, then insulin is required in patients with type 2 diabetes.

TABLE 6.6 • Diabetes oral agents

Medication Type		Drugs	Mechanism	Cautions
Insulin secretagogues	Sulfonylurea	Glyburide, Glipizide, Glimepiride	Insulin secretion stimulation	Risk of hypoglycemia
	Meglitinide analogs	Repaglinide, mitiglinide, nateglinide		Decrease incidence of hypoglycemia compared to Sulfonylurea's
Insulin sensitizers	Biguanides	Metformin	Reduces hepatic and renal gluconeogenesis	Risk of lactic acidosis
	Thiazolidinediones (TZDs)	Pioglitazone, Rosiglitazone, Troglitazone	PPAR gamma activation ↑ muscle and adipose tissue insulin sensitivity	Risk of heart failure, use has become limited
a -Glucosidase inhibitors		Acarbose, miglitol	Inhibit a -glucosidase at intestinal brush border Decrease absorption of carbohydrates in the GI tract	Results in GI side effects
Incretin Hormones	GLP-1 receptor agonists	Exenatide, liraglutide	Metabolically stable analog to endogenous GLP1 that acts on receptor to amplify postprandial insulin, induce satiety, etc. b-cell protection/proliferation	New agent, expensive, given by SLC injection Cardiovascular effects Weight reduction
	DDP-4 inhibitors	Linagliptin, alogliptin, saxagliptin	Inhibit DDP-4, which breaks down endogenous GLP-1	No weight effect

  - **Gestational diabetes:** diagnosis is made with a 50- or 75-g OGTT taken routinely by pregnant women. Dietary and exercise measures should be undertaken,

---

*Must be individualized; children, elderly, and those with frequent hypoglycemia and type 1 diabetes may require different targets.

DKA presents with hyperglycemia, hyperketonemia, and metabolic acidosis.

Consider HHS in severe hyperglycemia associated with altered mental status and dehydration

and women should be followed up by a comprehensive multidisciplinary team, including a dietitian, nurse, exercise physiologist, and physician. Glycemic control needs to be achieved promptly since hyperglycemia is associated with poor maternal (m), fetal (f), and neonatal (n) outcomes such as hypertension and preeclampsia (m), macrosomia, stillbirth polyhydramnios (f) and birth trauma, neonatal hypoglycemia, and hyperbilirubinemia (n). If glycemic control is not promptly achieved, insulin is the first-line medication used in pregnancy.

Acute Complications of DM

- DKA—diabetic ketoacidosis (usually in type 1 DM)
- HHS—hyperglycemic hyperosmolar state (usually in type 2 DM)
- Hypoglycemia, hypoglycemic seizure, hypoglycemic coma—can occur in either

Laboratory Investigations of DKA versus HHS (Figure 6.7)

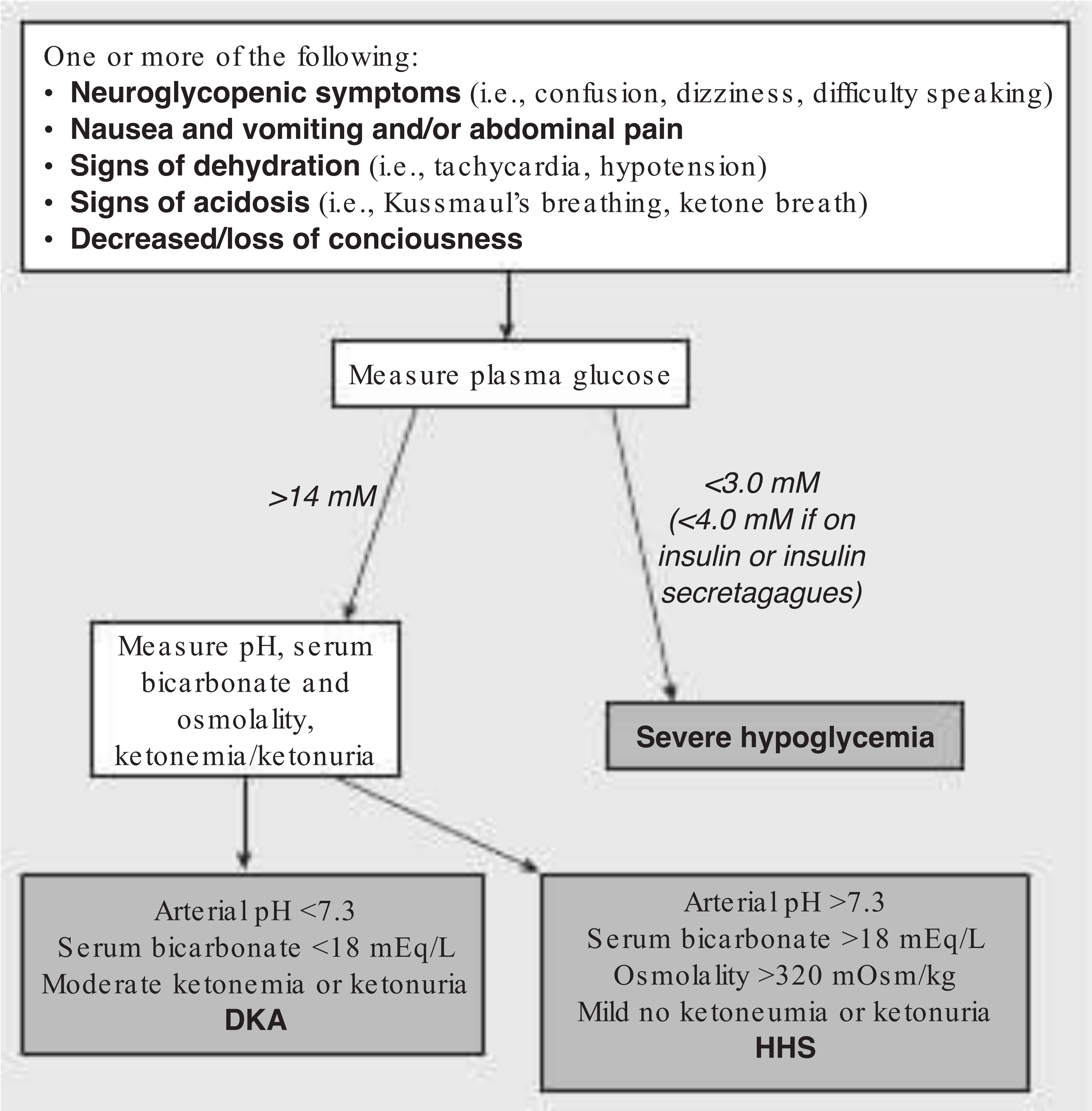

One or more of the following:
• **Neuroglycopenic symptoms** (i.e., confusion, dizziness, difficulty speaking)
• **Nausea and vomiting and/or abdominal pain**
• **Signs of dehydration** (i.e., tachycardia, hypotension)
• **Signs of acidosis** (i.e., Kussmaul's breathing, ketone breath)
• **Decreased/loss of conciousness**
Measure plasma glucose
>14 mM
<3.0 mM (<4.0 mM if on insulin or insulin secretagagues)
Measure pH, serum bicarbonate and osmolality, ketonemia/ketonuria
Severe hypoglycemia
Arterial pH <7.3
Serum bicarbonate <18 mEq/L
Moderate ketonemia or ketonuria
DKA
Arterial pH >7.3
Serum bicarbonate >18 mEq/L
Osmolality >320 mOsm/kg
Mild no ketoneumia or ketonuria
HHS

Figure 6.7. Diagnosis of acute complications of DM.

CLINICAL box

Treating DKA

1. Monitor. DKA is a life-threatening condition that requires close cardiopulmonary monitoring in a monitored bed. Electrolytes, blood osmolality, blood glucose, volume status, and ABGs should be monitored frequently.
2. IV Fluids. IV fluids are the corner stone of treatment. Normal saline is initially given to expand the intravascular volume. Expanding intravascular volume helps with renal function. IV fluids also help decrease plasma osmolality.
3. Insulin. IV insulin is given, and an insulin drip is started to close the anion gap caused by ketosis. It is important to titrate the insulin drip against the anion gap.
4. Potassium. When serum K is < 5.0 mEq/L, add supplemental K.
5. Glucose. When blood glucose is 15 mM, add glucose to the IV fluids.
6. Bicarbonate. If blood pH is less than 6.9, giving 1 to 2 amps of bicarb can be beneficial.
7. Treat any precipitating illness.

CLINICAL box

Treating Nonketotic Hyperosmolar Hyperglycemia

1. Monitor. HHS has high mortality and requires close cardiopulmonary monitoring in a monitored bed. ICU admission should be considered in some patients. Close monitoring of electrolytes, blood osmolality, blood glucose, volume status, and ABGs should be monitored frequently.
2. IV Fluids. IV fluids are the corner stone of treatment. Normal saline is initially given to expand the intravascular volume. Expanding intravascular volume helps with renal function.
3. Sodium monitoring. Remember to correct Na for glucose concentration (add 3 mEq/L for every 10 mmol/L of glucose above 10 mmol). Make sure serum Na does not drop more than 8 mEq/d to avoid cerebral edema.
4. Insulin. An insulin drip can be given to help correct glucose levels.
5. Treat any precipitating illness.

Chronic Complications (Table 6.7)

These encompass both microvascular disease (retinopathy, neuropathy, nephropathy) and macrovascular disease (atherosclerosis, CAD, cerebrovascular disease, peripheral vascular disease).

Large randomized studies have shown evidence for tighter glycemic control ($HbA_{1c} \leq 7\%$) for prevention of microvascular disease. There seems to be a linear relationship between glycemic control and microvascular complications.

Studies show that a multimodal multidisciplinary approach targeting lifestyle intervention, weight loss, smoking cessation, hypertension, dyslipidemia, and close follow-up in a specialized multidisciplinary team along with diabetes care can reduce cardiovascular outcomes. There is no evidence that targeting $HbA_{1c} < 7\%$ prevents cardiovascular mortality.

CLINICAL box

Hypoglycemia Unawareness

Hypoglycemia unawareness is the reduction or disappearance of adrenergic symptoms after years of insulin treatment.

This results in an ↑ risk of severe hypoglycemia with changes in mental status.

Prevention involves the meticulous avoidance of iatrogenic hypoglycemia by raising the target of insulin therapy.

TABLE 6.7 • Diagnosis of the chronic complications of diabetes

Complication	Screening Recommendations
Microvascular	
Retinopathy	Annual dilated fundoscopic exam by an ophthalmologist for nonproliferative and proliferative diabetic retinopathy Type 1 DM: start at 5 yr after diagnosis
Nephropathy	Annual screening for microalbuminuria: albumin excretion rate = 30–300 mg/24 h on 2/3 samples Type 1 DM: start at 3 yr duration or with the onset of puberty
Neuropathy	Annual screening for loss of sensitivity at big toes to 10 g monofilament or vibration Type 1 DM: start screening after 5 yr duration or with the onset of puberty
Macrovascular	Screen for presence of hypertension, dyslipidemia, and/or evidence of atherosclerosis, CAD, cerebrovascular, or peripheral vascular disease as per individual guidelines

HYPOGLYCEMIA

MCC OBJECTIVE

Based on Objective #37-1 (Glucose Abnormalities) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- The body and particularly the brain depend on glucose as an energy source.
- Hypoglycemia can be a life-threatening condition.
- The body has numerous counter-regulatory mechanisms to defend itself against hypoglycemia, including its ability to initiate gluconeogenesis, glycogenolysis, and switch to fatty acid oxidation for energy production to drive gluconeogenesis. Ketoacids made from free fatty acids can act as an alternative fuel for brain cells.

CLINICAL box

Hypoglycemia: Signs and Symptoms

Adrenergic: due to the perception of physiologic changes caused by autonomic nervous system activity	Neuroglycopenic: directly due to CNS neuronal glucose deprivation
Palpitations	Behavioral changes
Tremor	Confusion
Anxiety	Fatigue or weakness
Sweating	Warmth
Hunger	Visual changes
Paresthesia	Seizure
Pallor	Loss of consciousness
Diaphoresis	Death if prolonged or severe

CAUSAL CONDITIONS

Etiology of Hypoglycemia

The approach to identifying the etiology of hypoglycemia should separate patients into those with fasting hypoglycemia and those with nonfasting hypoglycemia. Fasting hypoglycemia should further be divided into two categories: high I:G ratio and low I:G ratio (see Table 6.8).

ASC box

Fasting Glucose Homeostasis

Several mechanisms maintain glucose homeostasis in response to falling plasma glucose concentrations:

1. Insulin suppression
2. Glucagon release
3. Epinephrine release
4. GH and cortisol release

Glucagon, epinephrine, GH, and cortisol are known as **counter-regulatory** (i.e., glucose-raising) factors.

TABLE 6.8 • Differential diagnosis of fasting hypoglycemia

Mechanism		Differential Diagnosis
High I:G	Adults	• Insulin/oral hypoglycemic overdose • Drugs: exogenous insulin, sulphonylureas, others (e.g., pentamidine, quinine) • Autoimmune: insulin or insulin receptor autoantibodies • Pancreatic beta cell tumor (insulinoma)
	Infants/pediatrics	• Maternal DM • Congenital hyperinsulinism
Low I:G	Adults	• Hepatic dysfunction • Hypocortisolism • Alcohol use • Starvation • Nonpancreatic tumors (making IGF-II)
	Infants/pediatrics	• Premature • Sepsis

CLINICAL box

Whipple's Triad

Fulfillment of Whipple's triad provides compelling evidence for hypoglycemia:

1. Low plasma glucose (< 3.0 mmol/L)
2. Signs/symptoms of hypoglycemia
3. Relief of symptoms when plasma glucose raised

Nonfasting causes of hypoglycemia include alimentary, functional, noninsulinoma pancreatogenous hypoglycemic syndrome (NIPHS), occult diabetes, and ethanol ingestion with sugar mixers.

!

Hypoglycemia presents differently in infants, and can include apnea, cyanotic spells, hypothermia, hypotonia, and poor feeding. Infants and children are less tolerant to fasting than adults.

APPROACH

Signs/Symptoms

Signs and symptoms of hypoglycemia can be divided into two categories: (1) Adrenergic symptoms occur early (plasma glucose < 3.3 mmol/L) and act as "warning signs" about impending hypoglycemia while mobilizing alternative fuel sources and stimulating appetite; (2) neuroglycopenic symptoms occur later (plasma glucose < 2.8 mmol/L) as a direct result of glucose deprivation to the brain.

Diagnosis (Figure 6.8)

- History and physical exam as well as basic blood work are key to identifying obvious causes such as hepatic, renal failure, adrenal insufficiency, or severe alcoholism. These causes of hypoglycemia must be ruled out.
- If etiology remains occult, hypoglycemia on a *venous* blood sample must be documented at the time of symptoms or during a supervised fast.
- A critical sample is required and involves simultaneous measurement of insulin, C-peptide, proinsulin, ketones, and sulfonylurea or other insulin secretagogue

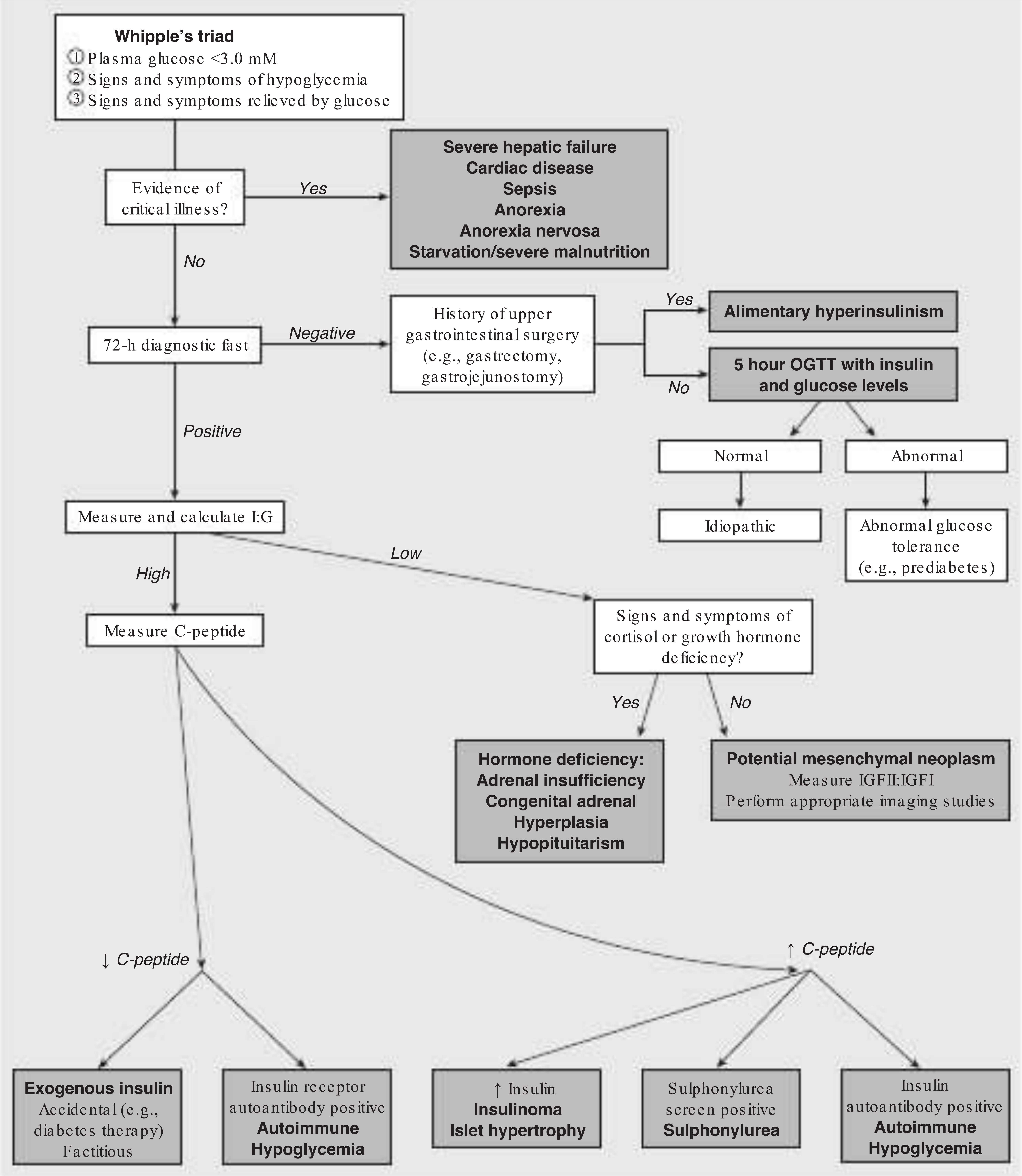

Whipple's triad
① Plasma glucose <3.0 mM
② Signs and symptoms of hypoglycemia
③ Signs and symptoms relieved by glucose
Evidence of critical illness?
Yes
Severe hepatic failure
Cardiac disease
Sepsis
Anorexia
Anorexia nervosa
Starvation/severe malnutrition
No
72-h diagnostic fast
Negative
History of upper gastrointestinal surgery (e.g., gastrectomy, gastrojejunostomy)
Yes
Alimentary hyperinsulinism
No
5 hour OGTT with insulin and glucose levels
Normal
Abnormal
Idiopathic
Abnormal glucose tolerance (e.g., prediabetes)
Positive
Measure and calculate I:G
Low
Signs and symptoms of cortisol or growth hormone deficiency?
Yes
No
Hormone deficiency: Adrenal insufficiency Congenital adrenal Hyperplasia Hypopituitarism
Potential mesenchymal neoplasm
Measure IGFII:IGFI
Perform appropriate imaging studies
High
Measure C-peptide
↓ C-peptide
↑ C-peptide
Exogenous insulin
Accidental (e.g., diabetes therapy)
Factitious
Insulin receptor autoantibody positive
Autoimmune Hypoglycemia
↑ Insulin
Insulinoma
Islet hypertrophy
Sulphonylurea screen positive
Sulphonylurea
Insulin autoantibody positive
Autoimmune Hypoglycemia

Figure 6.8. Approach to investigating hypoglycemia.

measurement while the patient is hypoglycemic. This information will narrow the differential and guide further investigations.

- If required, patients undergo a 72-h supervised fast with regular glucose measurements until hypoglycemia is documented and critical sample is obtained.

Consider actue adrenal insufficiency when unexplained hypoglycemia presents in the context of hypotension, hyponatremia, ± hyperkalemia.

Management (Table 6.9)

- Urgent treatment of symptomatic hypoglycemia is essential.
- Plasma glucose should be normalized once hypoglycemia is documented while investigations ensue for the cause of hypoglycemia.
- More targeted therapy for hypoglycemia should take place once the etiology has been clarified (e.g., diazoxide for insulinoma while tumor localization takes place, correction of hypocortisolism in adrenal insufficiency, resection of IGF-II producing tumor, alcohol cessation, etc.).

TABLE 6.9 • Acute management of hypoglycemia

Degree of Hypoglycemia	Cause	Treatment
Mild-moderate	All	15 g of carbohydrate Plasma glucose retested 15 min later and re-treated if still < 4.0 mmol/L
Severe	Insulin mediated	Glucagon 1 mg IM or 50 mL 50% glucose solution by IV
	Noninsulin mediated	50 mL 50% and/or glucose solution by IV
		Supervision in medical setting with ongoing treatment as needed

ADRENOCORTICAL INSUFFICIENCY (AI)

MCC OBJECTIVE

Covered in Objective #37-1 (Glucose Abnormalities) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- **Primary:** destruction/dysfunction of adrenal cortex leads to deficiency of cortisol, mineralocorticoids (aldosterone), and adrenal androgens.
- **Secondary:** deficient pituitary ACTH secretion leads to deficiency of cortisol and adrenal androgens, but mineralocorticoid function is preserved. Over time, loss of ACTH stimulation causes atrophy of zonae fasciculata and reticularis of the adrenal cortex.

CAUSAL CONDITIONS AND APPROACH

PRIMARY AI

Causes

- Autoimmune adrenocortical insufficiency (adrenalitis). Can be associated with polyglandular autoimmune syndromes
- Adrenal hemorrhage
- Infection (TB is a common cause in developing world, fungal, HIV/AIDS)
- Adrenoleukodystrophy (X-linked)
- Metastatic adrenal disease
- Drug-induced (ketoconazole, metyrapone, etomidate, etc.)

Symptoms

Chronic symptoms: weakness, fatigue, nausea, vomiting, weight loss

Signs

- Hypotension, hyponatremia (renal salt wasting), hypoglycemia, hyperkalemia, acidosis.
- Hyperpigmentation (due to ACTH stimulation of melanocytes), low weight, orthostatic hypotension.
- Acute adrenal crisis: endocrine emergency. Can be brought on by illness or stress. Can present in hypovolemic shock and vascular collapse. Abdominal pain can look like acute abdomen.

Diagnosis (Figure 6.9)

- Low cortisol level with high ACTH level in the correct clinical context can be diagnostic.

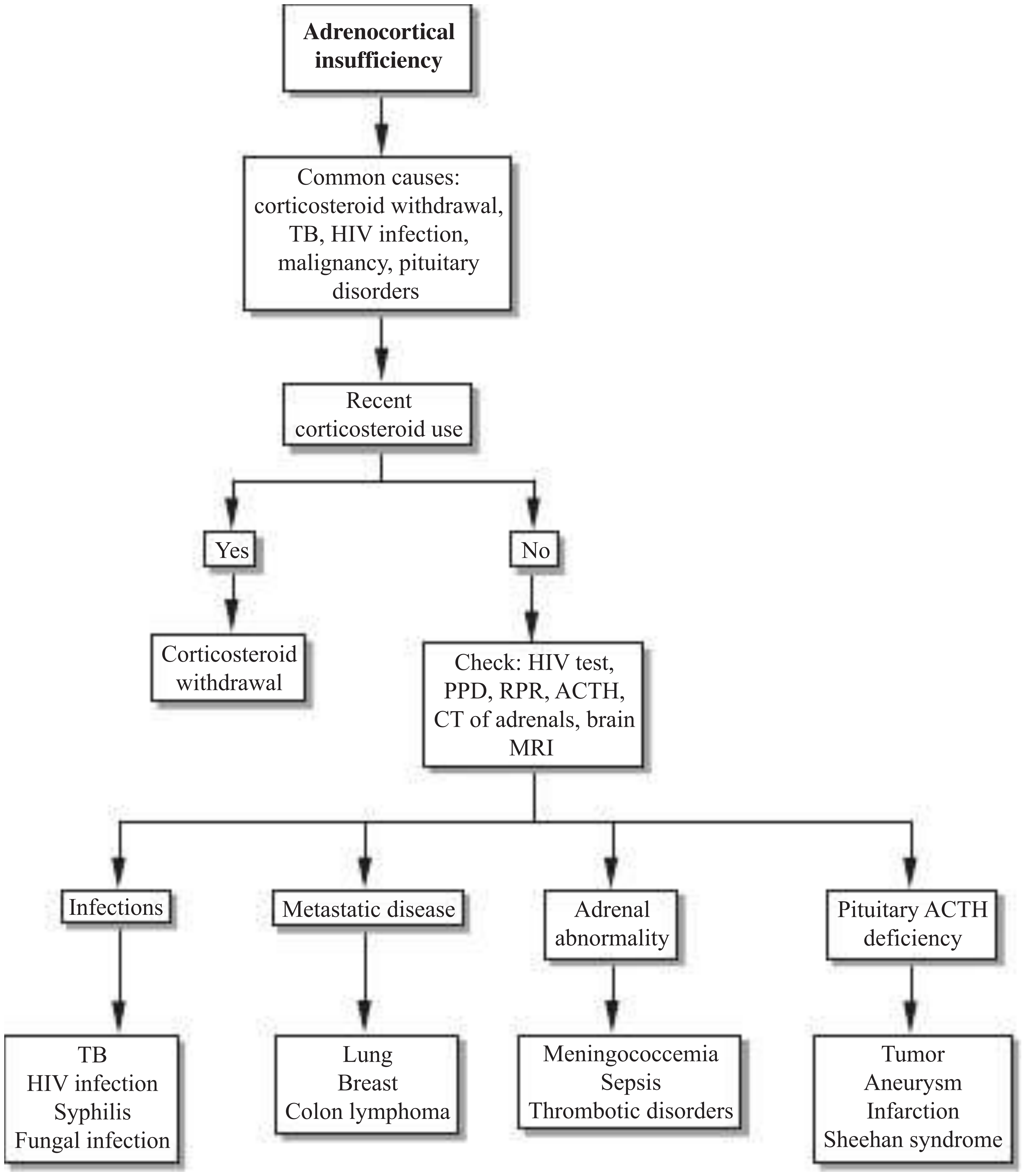

Adrenocortical insufficiency
Common causes: corticosteroid withdrawal, TB, HIV infection, malignancy, pituitary disorders
Recent corticosteroid use
Yes
No
Corticosteroid withdrawal
Check: HIV test, PPD, RPR, ACTH, CT of adrenals, brain MRI
Infections
Metastatic disease
Adrenal abnormality
Pituitary ACTH deficiency
TB
HIV infection
Syphilis
Fungal infection
Lung
Breast
Colon lymphoma
Meningococcemia
Sepsis
Thrombotic disorders
Tumor
Aneurysm
Infarction
Sheehan syndrome

Figure 6.9. Adrenocortical insufficiency. PPD skin test for TB, RPR for syphilis.

- Cosyntropin (ACTH) stimulation test quantifies adrenal reserve. Cortisol measured at baseline, 30 min, 60 min postadministration of 250 μg ACTH IV. Cortisol $>$ 550 nmol/L is a normal response.

Treatment

- Corticosteroid and mineralocorticoid replacement. No need for adrenal androgen replacement.
- Need to work up the etiology.

Secondary AI

Causes

- Exogenous glucocorticoid therapy (most common)
- Pituitary tumor
- Infarction (Sheehan‘s syndrome, apoplexy)
- Pituitary infiltration (sarcoidosis, hemochromatosis, Langerhan‘s histiocytosis)
- Lymphocytic hypophysitis (immunologic)
- Trauma/surgery/radiation
- Infection (rare)

Signs/Symptoms

- These can be similar to primary AI. More commonly, symptoms are nonspecific (lethargy, fatigue, nausea, malaise). Patients may present with adrenal crisis in the face of illness or stress.
- There is *no* hyperpigmentation since ACTH is not elevated. Volume depletion and hyperkalemia are absent since mineralocorticoid function is intact.

Diagnosis

- Low cortisol level with low or normal ACTH is suggestive.
- Must measure pituitary reserve. Cosyntropin stimulation test is only useful if *abnormal* (indicating chronic ACTH depletion has led to adrenocortical atrophy).
- A normal response **does not** rule out secondary AI. Tests of ACTH reserve include metyrapone test or insulin-induced hypoglycemia test.

Treatment

- Corticosteroid replacement. Workup of etiology and evaluation of other pituitary hormones. No need for mineralocorticoid replacement.

THYROID DISEASE

MCC OBJECTIVE

Based on Objective #63 (Neck Mass, Goiter, Thyroid Disease) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

ASC box

Iodine is essential for thyroid hormone synthesis.

- Dietary iodine is converted to iodide and taken up by the thyroid gland by the iodine symporter.
- Thyroid peroxidase uses the iodide to assemble T_3 and T_4 and the protein thyroglobulin within follicular cells.
- T_3, T_4, and thyroglobulin are co-secreted from the thyroid.

APPLIED SCIENTIFIC CONCEPTS (Figure 6.10)

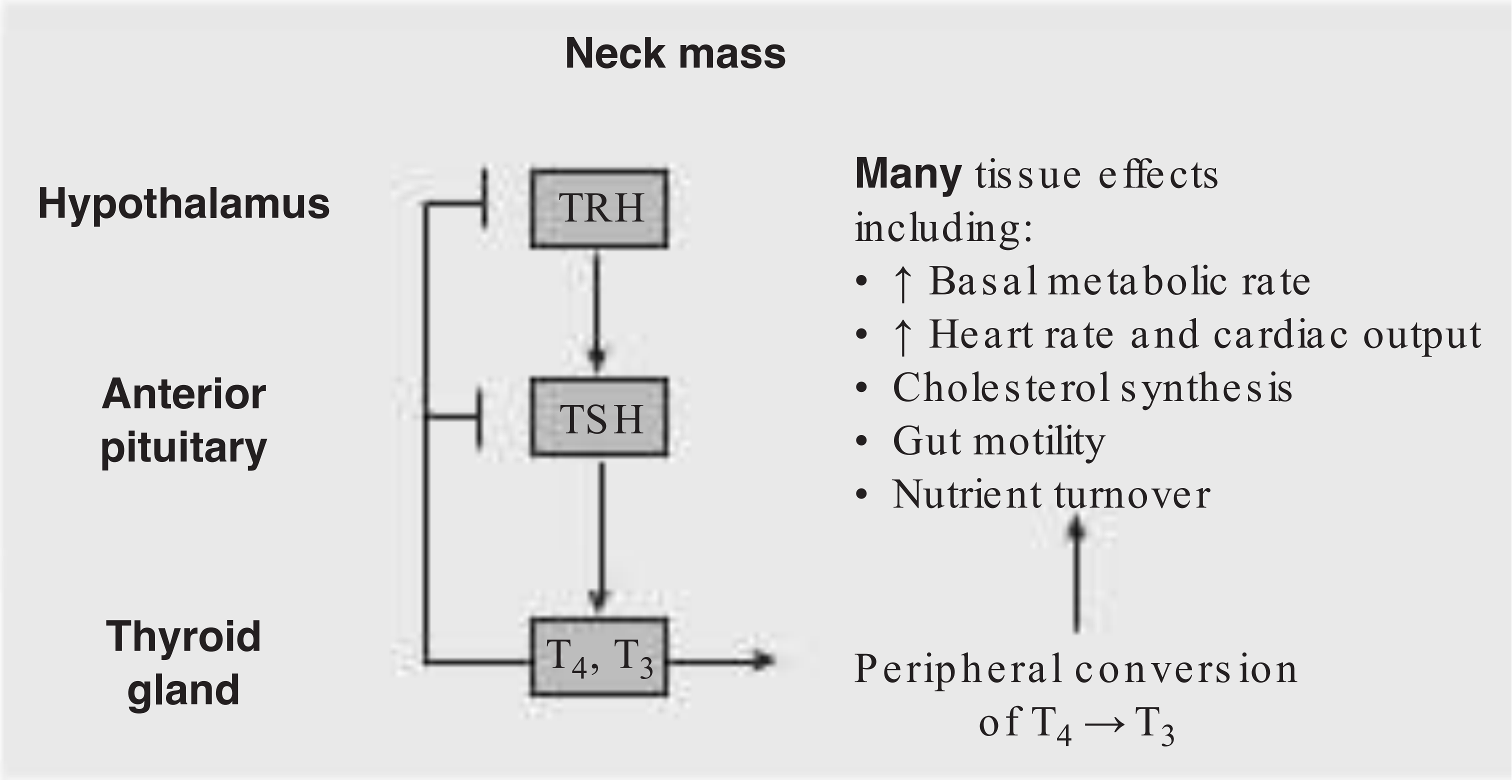


Figure 6.10. The hypothalamic–pituitary–thyroid axis. T_4 is the major secretory product, and T_3 is the more bioactive form. T_4 is converted by peripheral deiodinases in liver, pituitary, hypothalamus, and other tissues, to the bioactive T_3 form. T_3 is the hormone responsible for feedback inhibition on TRH and TSH secretion.

Clinically Relevant Proteins and Hormones

- T_4: biologically active thyroid hormone produced in greater quantities, but less potent than T_3.
- T_3: biologically active thyroid hormone produced in lower quantities, but more potent than T_4.
- Thyroid peroxidase: enzyme responsible for release of free T_4, T_3. Antibodies against this enzyme are produced in Hashimoto thyroiditis.
- TSH: binds to receptor and upregulates T_3 and T_4 release.
- Thyroid-binding globulin: binds T_3 and T_4 in bloodstream (Figure 6.11).

CAUSAL CONDITIONS AND APPROACHES

Hypothyroidism

Causal Conditions

Primary Hypothyroidism

Intrinsic pathology related to the thyroid gland and its failure to produce thyroid hormones.

Secondary Hypothyroidism

Failure of the pituitary gland to secrete TSH

The most common cause of hypothyroidism is Hashimoto thyroiditis. Persons with Hashimoto thyroiditis may have episodes of transient hyper- or hypothyroidism that resolve spontaneously, usually lasting less than 3 to 6 mo.

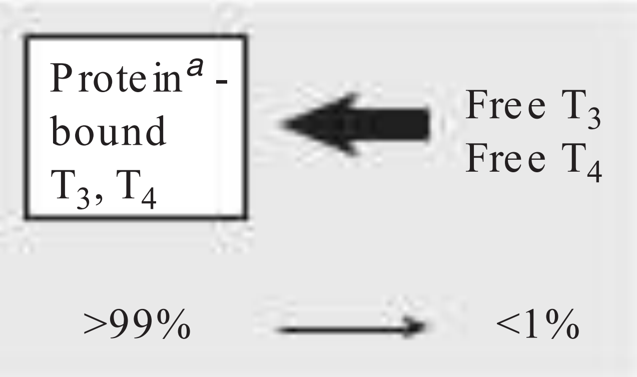


Figure 6.11. Protein binding profile of thyroid hormones. Less than 1% is free and biologically active. [a]Proteins include thyroid-binding globulin, albumin. Thyroid-binding globulin increases with estrogen.

Differential Diagnosis of Primary and Secondary Hypothyroidism (Table 6.10)

TABLE 6.10 • Differential diagnosis of primary and secondary hypothyroidism

Primary Hypothyroidism	Secondary Hypothyroidism
1. Autoimmune (Hashimoto thyroiditis)	1. Hypopituitarism
2. Iatrogenic—^{131}I or thyroidectomy	2. Tumors
3. Iodine deficiency	3. Surgery
4. Drugs—amiodarone, contrast, lithium	4. Sheehan's syndrome
5. Congenital	

Laboratory Evaluation

- TSH, free T_4, TPO antibodies

Treatment

- Exogenous thyroid hormone—titrate to symptoms and TSH levels and check levels every 6 to 8 wk
- Adults with heart disease—careful with titrations as thyroid hormone increases myocardial oxygen demand. Risk of atrial fibrillation and decreased bone density

Subclinical Hypothyroidism

TSH ↑ at 4–10 IU/L, normal free T_4 and free T_3. Minimal or no symptoms. Most resolve over 1 yr. Indications for thyroxine therapy: pregnancy, goiter, positive TPO Ab, symptoms persisting, TSH elevation > 1 yr (arbitrary), hypercholesterolemia, depression, infertility.

CLINICAL box

Signs/Symptoms

Symptoms: fatigue, lethargy, cold intolerance, weight gain, muscle cramps, sleepiness, decreased mental functioning, memory and learning, constipation, menorrhagia

Signs: slow speech, hoarse voice, goiter, dry coarse hair and skin, alopecia, periorbital or peripheral edema, bradycardia, diastolic hypertension, delayed relaxation phase of deep tendon reflex

CLINICAL box

Myxoedema Coma

Severe hypothyroid state characterized by severe lethargy and reduced level of consciousness including coma, seizures, hypothermia, bradycardia, and hypotension. Occurs in the setting of an acute intercurrent illness superimposed on underlying untreated hypothyroidism.

Hyperthyroidism

Causal Conditions (Figure 6.12)

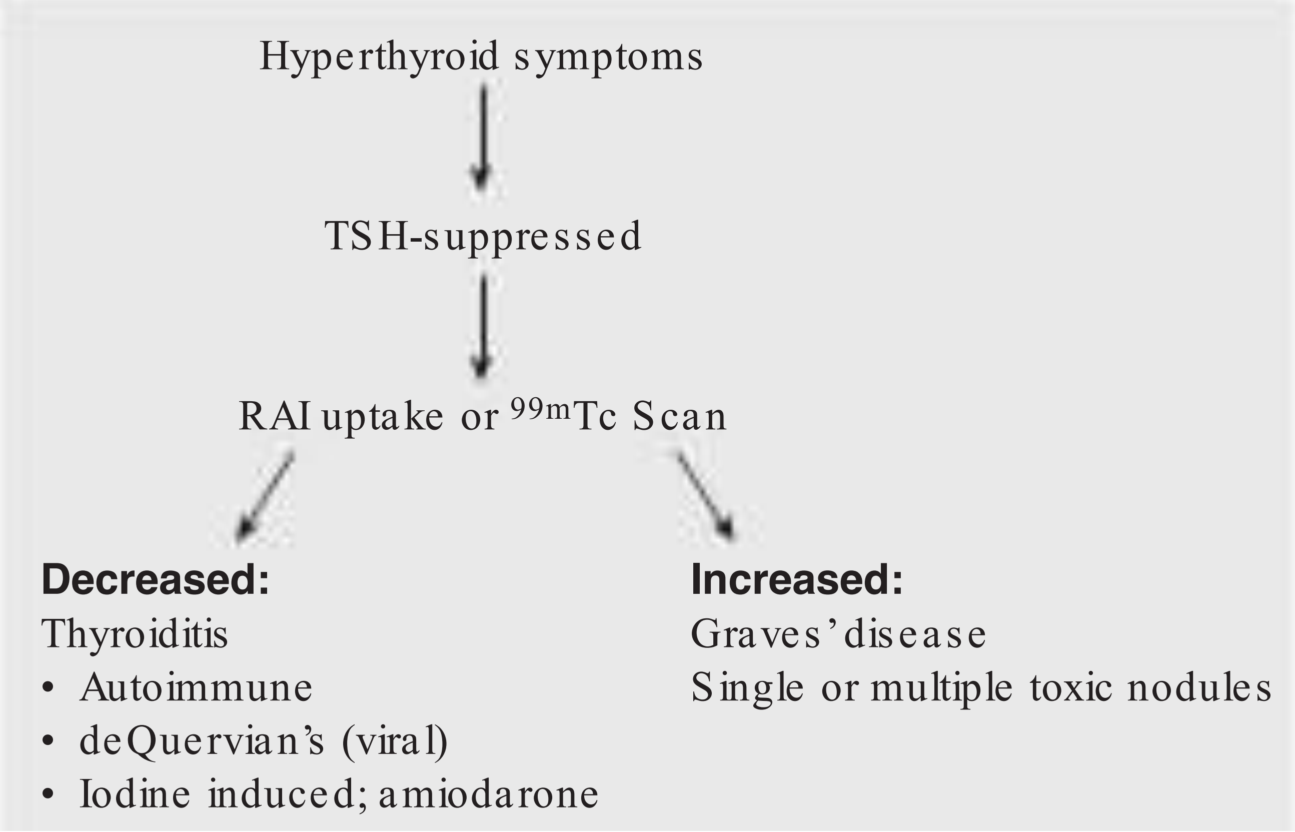


Figure 6.12. Diagnosis of hyperthyroidism and thyroiditis.

Graves Disease

- Autoimmune activation of TSH receptor via thyroid-stimulating immunoglobulins

Toxic Multinodular Goiter

- Multiple thyroid nodules producing a net excess of thyroid hormone

Solitary Toxic Nodule

- One thyroid nodule producing a net excess of thyroid hormone

Thyroiditis

- Thyroid inflammation that results in release of stored thyroid hormones, initially leading to thyroid excess

Thyroid Factitia

- Ingestion of exogenous thyroid hormone

CLINICAL box

Symptoms and Signs of Hyperthyroidism

Symptoms: nervousness, tremor, increased sweating, heat intolerance, fatigue, weight loss, muscle weakness, palpitations, tachycardia, diarrhea, decreased menstrual flow (females), gynecomastia (males)

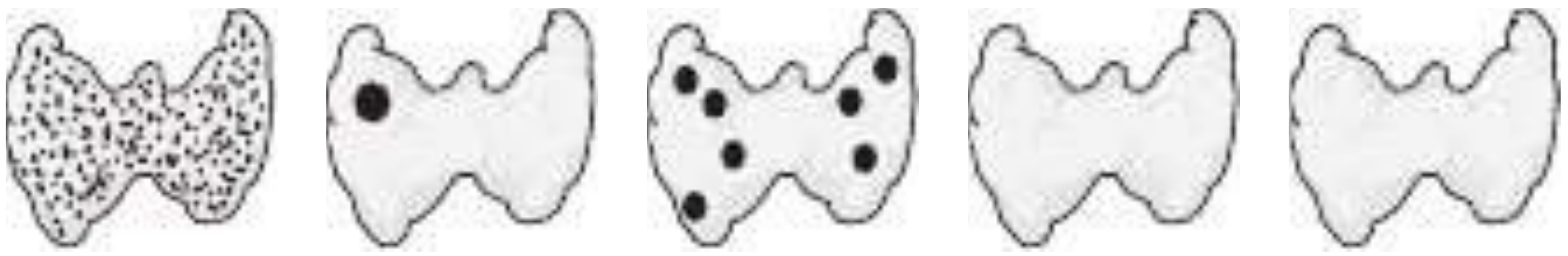
Signs: warm, sweaty skin, fine tremor, eyelid retraction, lid lag, goiter, tachycardia, increased pulse pressure, systolic (but not diastolic) hypertension, thyroid bruit, diarrhea, gynecomastia, increased deep tendon reflexes, muscle weakness (predominantly shoulder and hip girdle); may cause atrial fibrillation

Autoimmune features specific to Graves disease: (1) ophthalmopathy (proptosis, diplopia, extraocular muscle movement abnormalities, inflammatory findings [chemosis, tearing, photophobia, periorbital edema, redness, pain], papilledema), (2) pretibial myxedema, (3) acropachy (finger clubbing).

Laboratory Evaluation

- TSH, free T_4 and free T_3, thyroid scan
- TSH receptor antibodies (Graves disease)
- TPO antibodies (positive in all autoimmune thyroid disease)

Thyroid Scan Findings (Figure 6.13)



Graves' disease | Solitary toxic nodule | Toxic multi-nodular goiter | Thyroiditis | Thyrotoxicosis factitia

Figure 6.13. Thyroid scan findings.

Treatment Options

Graves Disease

- Antithyroid drugs: propylthiouracil (PTU) or methimazole, b-blockers
- ^{131}I therapy
- Surgery Toxic Multinodular Goiter
- Same options as Graves disease

Solitary Toxic Nodule

- Surgery

Thyroiditis (Figure 6.14)

CLINICAL box

Thyroid storm: Severe form of thyrotoxicosis characterized by agitation, fever, delirium, seizure, vomiting, diarrhea, atrial fibrillation, and high output failure. Treatment is acute administration of propylthiouracil, b-blockers, dexamethasone, and iodide.

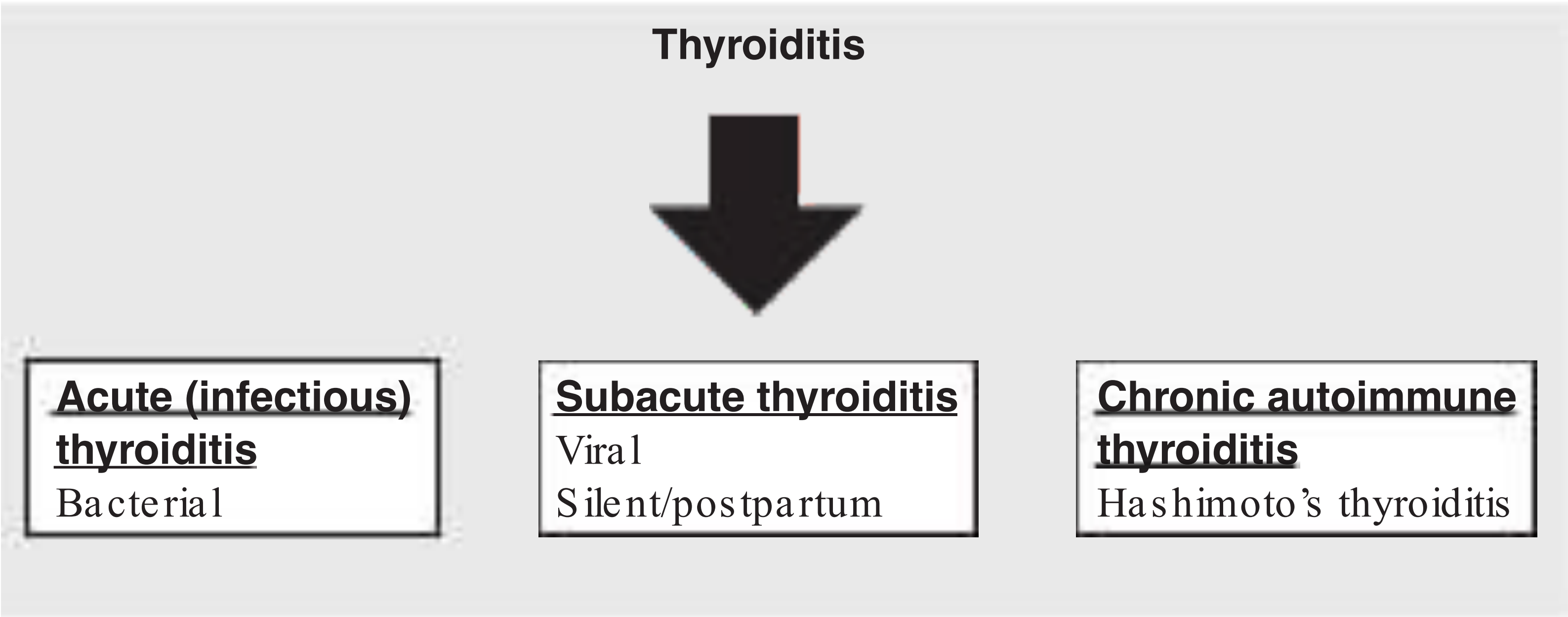


Figure 6.14. Thyroiditis.

Acute Thyroiditis (Bacterial)

- Painful thyroid, infectious symptoms
- Increased ESR and WBC
- Management: Fine needle aspirate and Gram stain. Treat underlying infection.

Subacute Thyroiditis (Viral) (Figure 6.15)

- Painful thyroid, diagnosis confirmed by increase in ESR and low iodine uptake
- A subacute form of thyroiditis manifested by thyrotoxicosis for approximately 1 mo and hypothyroidism for 1 to 3 mo
- Management: b-blockers for thyrotoxic symptoms. NSAID for pain control, if not effective, consider prednisone. Levothyroxine during the hypothyroid phase.

Silent or Postpartum Thyroiditis (See Figure 6.15)

- Clinical course similar to subacute thyroiditis but histologically a milder form of Hashimoto thyroiditis; may lead to permanent hypothyroidism
- Normal ESR
- Can occur typically 3 to 6 mo postpartum, hence also called postpartum thyroiditis
- Management: mild symptoms, no treatment required. Consider b-blockers to control thyrotoxic symptoms and levothyroxine during the hypothyroid phase.

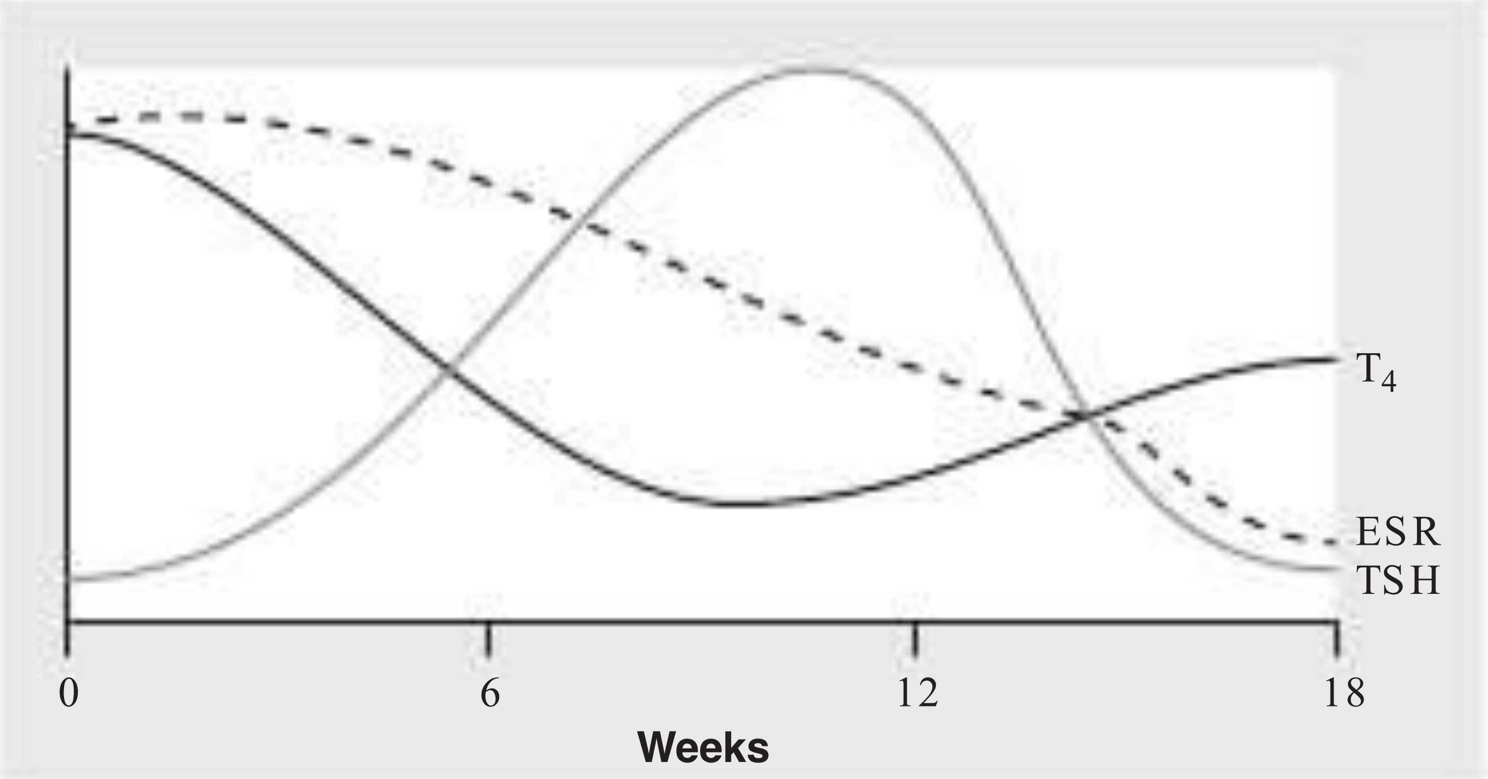


Figure 6.15. Subacute thyroiditis clinical course.

Thyroid Disease and Pregnancy

- Untreated hypothyroidism in pregnancy may result in impaired fetal cognitive development.
- Consider screening with a TSH (before or in the first trimester of pregnancy).
- An elevated TSH in pregnancy demands prompt thyroxine therapy.
- Pregnant women on thyroxine often need an increase in thyroxine dosage (TSH testing every 4–6 wk during pregnancy for dosage adjustment).
- A suppressed TSH in the first trimester may be due to hCG stimulating excess T_4 production and needs to be distinguished from Graves disease or other causes of hyperthyroidism.

Thyroid Cancer/Nodule (Table 6.11)

- Thyroid cancer typically presents as a firm palpable nodule and is more common in women.
- Most thyroid nodules are benign.

TABLE 6.11 • Primary thyroid cancer

Papillary	Most common, can be diagnosed by FNA/surgical resection Excellent prognosis, lymphatic spread
Follicular	Spreads hematologically (bone, lung, brain), sometimes cannot be diagnosed by FNA
Medullary	Tumor of the parafollicular cells which secrete calcitonin. Associated with multiple endocrine neoplasia syndromes
Anaplastic	Poorly differentiated and aggressive. Poor prognosis (commonly < 6 mo)
Metastatic	Metastasis to the thyroid from other areas

- Euthyroid hypoechoic nodules over 1 cm in size require needle biopsy to exclude malignancy.
- Clinical risk factors for malignancy:
  - Family history of thyroid cancer
  - MEN-2
  - Age < 20 or > 50 yr
  - Male
  - History of head or neck irradiation in childhood/adolescence
  - Hard consistency
  - Rapid growth
  - Fixation to adjacent structures
  - Vocal cord paralysis

- Neck adenopathy
- Suspicious features on ultrasound (hypoechoic, microcalcification, vascularity, irregular margins)

Approach to Investigating Thyroid Nodules (Figure 6.16)

Treatment

Treatment is usually surgery, radioactive iodine, or chemotherapy depending on the patient circumstances.

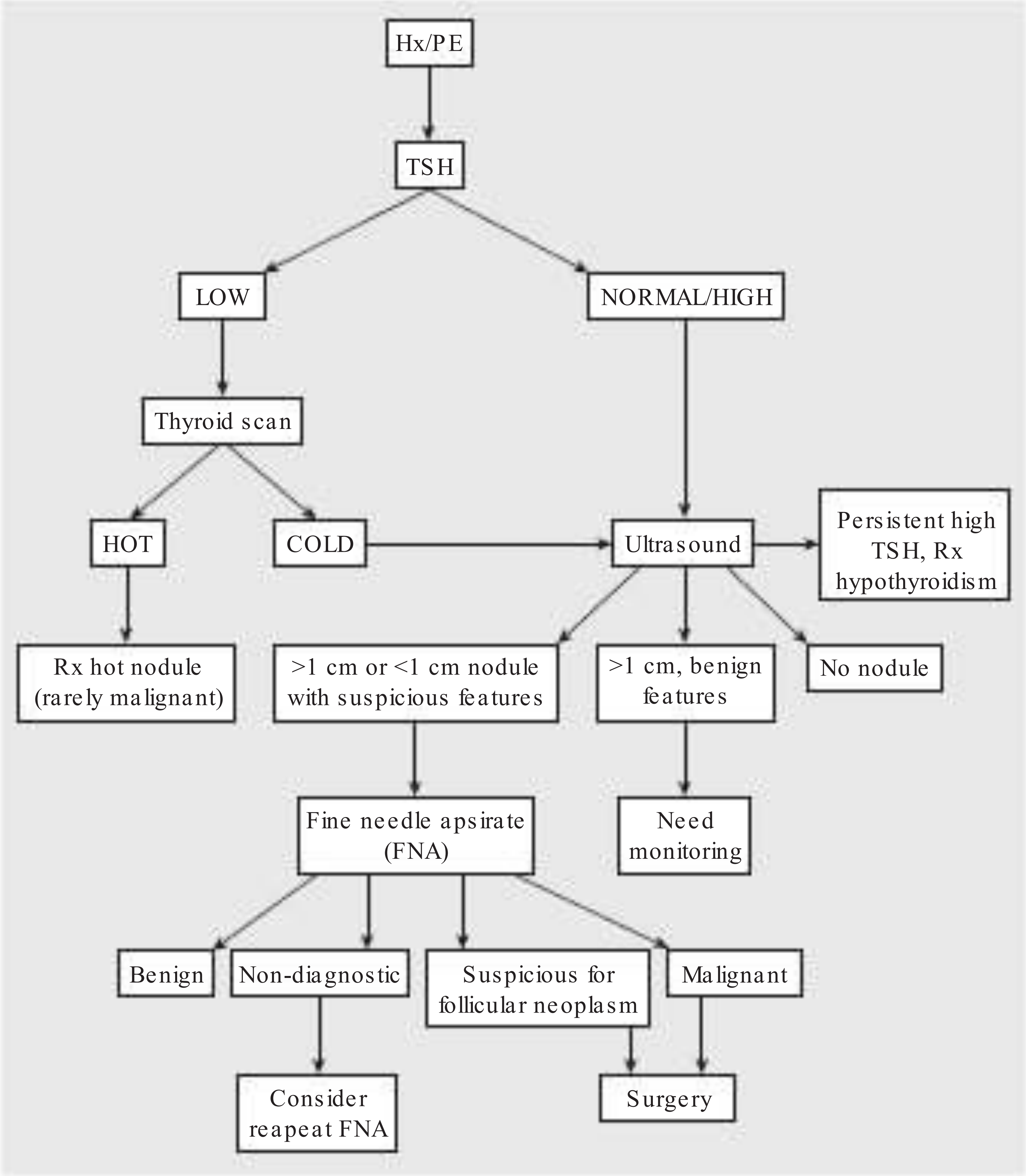

Hx/PE
TSH
LOW
NORMAL/HIGH
Thyroid scan
HOT
COLD
Ultrasound
Persistent high TSH, Rx hypothyroidism
Rx hot nodule (rarely malignant)
>1 cm or <1 cm nodule with suspicious features
>1 cm, benign features
No nodule
Fine needle apsirate (FNA)
Need monitoring
Benign
Non-diagnostic
Suspicious for follicular neoplasm
Malignant
Consider reapeat FNA
Surgery

Figure 6.16. Approach to investigating thyroid nodules. TSH is used to determine whether the nodule is active or "hot" (low TSH) as these are typically benign. FNA is used to further characterize a "cold" nodule.

SUGGESTED READINGS

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CHAPTER

7

Gastroenterology

Stephen E. Congly • Tiffany Poon • Erin Ross • Matthew Sadler

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Abnormal Liver Function Tests
Adult Jaundice
Allergic Reactions / Food Allergies, Intolerance, Atopy

DYSPHAGIA

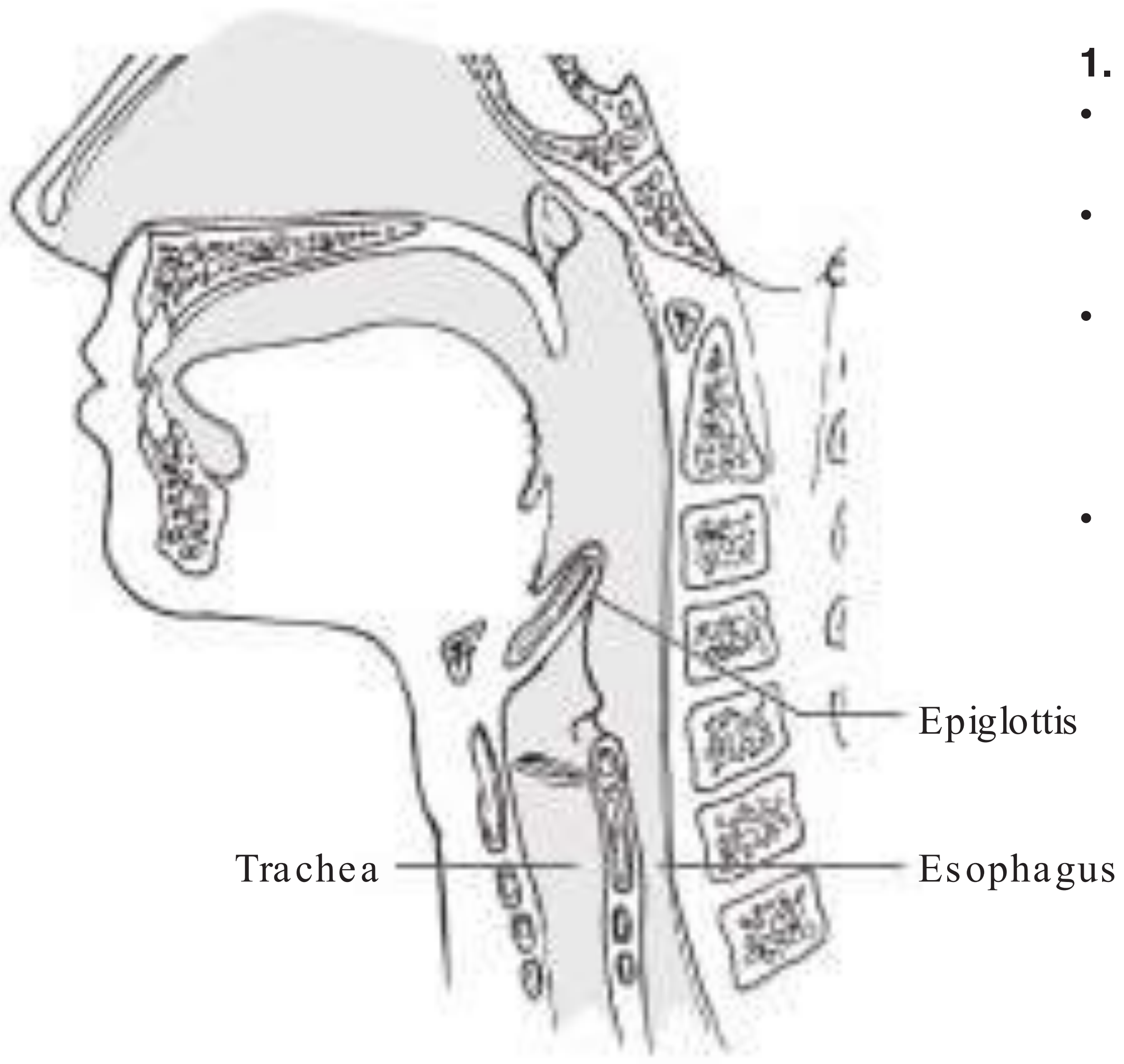
MCC Objective

Based on Objective #26 (Dysphagia) of *Objectives for the Qualifying Examination*, 3rd edition.

Overview

- Difficulty swallowing causing sensation of food sticking; food may remain in mouth, pharynx, or esophagus

Applied Scientific Concepts (Figure 7.1)



1. **Oral preparatory phase**
   - Convert food to semisolid state **(bolus)**
   - Bolus propelled toward the pharynx
   - Affected by poor dentition, salivary gland disorders, neurologic disorders, tounge weakness
   - Voluntary control involving CN V, VII, and XII

2. **Pharyngeal phase (1 s)**
   - Bolus stimulates tactile receptors in pharynx
   - Soft palate elevated—complete closure of nasopharynx (prevents regurgitation)
   - Elevation of larynx—inhibition of respiration (prevents aspiration)
   - Peristaltic action by pharyngeal constrictors propels bolus from pharynx to cricopharyngeal sphincter
   - Cricopharyngeal sphincter relaxes—food enters esophagus
   - Soft palate and larynx releases
   - Reflexive control involving CN V, X, XI, XII and central inhibition of respiration

3. **Esophageal phase (8–20 s)**
   - Transit time from cricoesphageal to gastroesophageal junction

Figure 7.1. Phases of swallowing.

History

- Location and timing of dysphagia
  - Early in swallow suggests oropharyngeal, while later suggests esophageal
- Solids/liquids or both
- Intermittent/progressive in character
- Hx of reflux
- Presence of odynophagia (pain with swallowing)
- Hx of dry mouth/dry eyes
- Worrisome features (weight loss, fevers, chills, night sweats) (see Figure 7.2)

Physical exam

- Head and neck: enlarged lymph nodes, goiter
- Neurologic: level of consciousness, cranial nerve defects
- Respiratory: aspiration pneumonia
- Abdominal: masses

CAUSAL CONDITIONS (Table 7.1)

TABLE 7.1 • Oropharyngeal versus esophageal dysphagia

Oropharyngeal Dysphagia				
Neuromuscular				
CNS	Cranial Nerves	Myopathic	Functional	Structural
Cerebral palsy CNS tumor Head trauma Parkinson's Dementia CVA	Laryngeal nerve palsy Polio MS ALS Diabetes	Polymyositis Myasthenia Dermatomyositis	Xerostomia	Zenker diverticulum Upper esophageal ring/web
Esophageal Dysphagia				
Mechanical			Motility	
Intrinsic		Extrinsic		
Intermittent	Progressive		Intermittent	Progressive
Lower esophageal ring or web	Peptic stricture Carcinoma	Mediastinal mass (goiter, tumor)	Diffuse esophageal spasm	Scleroderma Achalasia

APPROACH (Figure 7.2)

Investigations

- Oropharyngeal
  - Bedside swallowing study
  - Video swallowing study
  - CT head (for any CNS issues)
- Mechanical
  - Diagnostic imaging
    - Barium swallow (shows structural problems)
    - CT chest/abdomen (for extrinsic cause)
  - Endoscopy
    - Shows structural problems, can obtain biopsies and offer treatment
- Neuromuscular
  - Manometry (to measure pressure of muscle contractions in esophagus)

Diagnosis

- History key in determining investigations
- Endoscopy gold standard for intrinsic etiologies; may require biopsy
- Esophageal motility key first test for distinguishing between neuromuscular etiologies

Alarm features: weight loss, night sweats, age > 50 yr

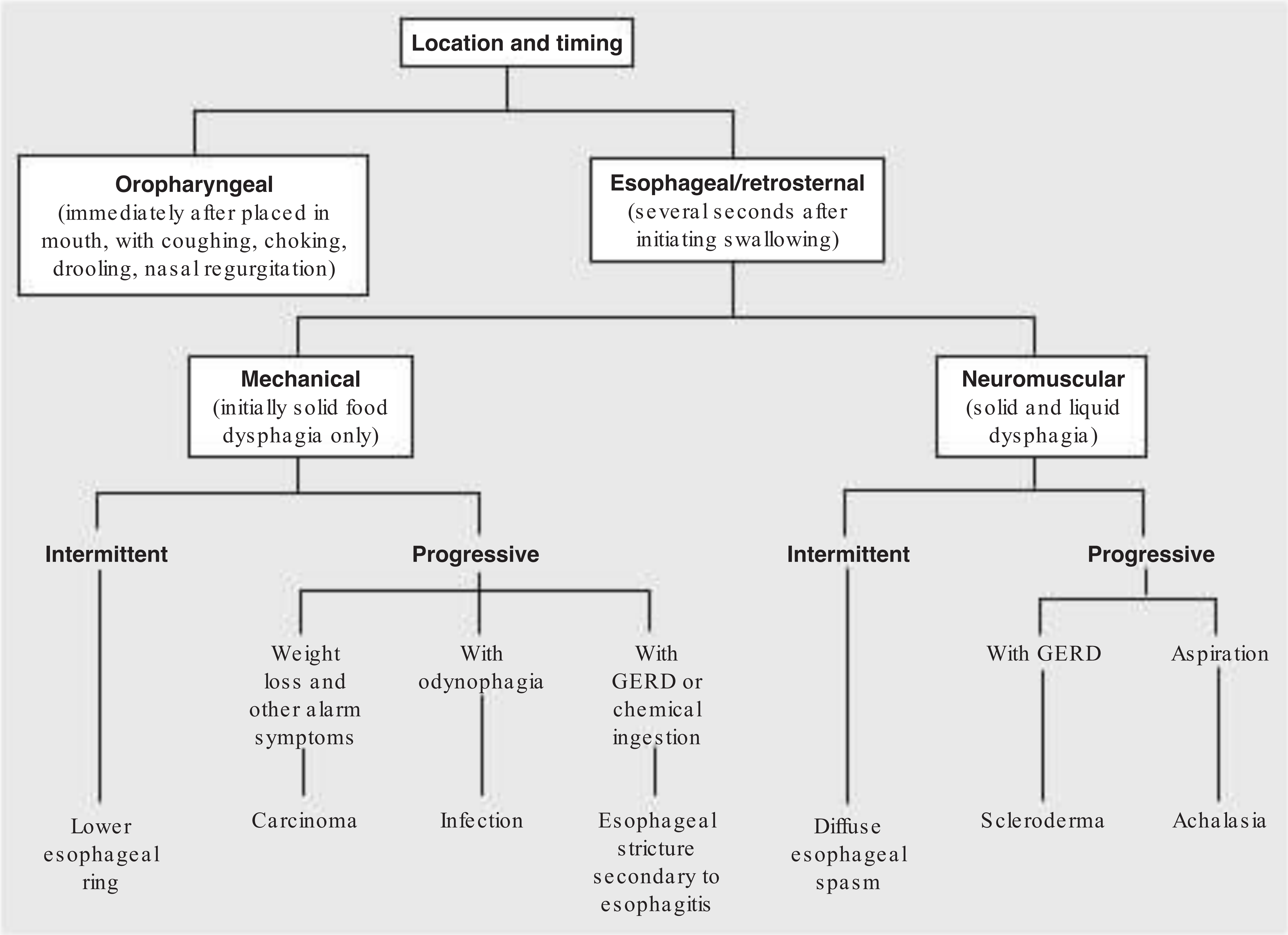

Location and timing
Oropharyngeal
(immediately after placed in mouth, with coughing, choking, drooling, nasal regurgitation)
Esophageal/retrosternal
(several seconds after initiating swallowing)
Mechanical
(initially solid food dysphagia only)
Neuromuscular
(solid and liquid dysphagia)
Intermittent
Progressive
Intermittent
Progressive
Weight loss and other alarm symptoms
With odynophagia
With GERD or chemical ingestion
With GERD
Aspiration
Lower esophageal ring
Carcinoma
Infection
Esophageal stricture secondary to esophagitis
Diffuse esophageal spasm
Scleroderma
Achalasia

Figure 7.2. Approach to dysphagia.

Management

- Management strategies based on underlying diagnosis

Oropharyngeal

- Referral to speech language therapy for swallowing strategies
- Xerostomia may benefit from saliva replacement
- Depending on Hx, may require referral to a rheumatologist, neurologist

Mechanical

- If worrisome symptoms/alarm features, urgent referral to gastroenterology
- Ring/stricture: may be treated with endoscopy
- Infection: treat underlying cause
- Carcinoma: biopsy, referral to surgeon

Neuromuscular

- Referral to a gastroenterologist for assessment and management

VOMITING / NAUSEA

MCC OBJECTIVE

Based on Objective #116 (Vomiting and/or Nausea) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Nausea is an unpleasant subjective sensation resulting from stimulation of gastrointestinal lining, chemoreceptor trigger zone (CTZ), vestibular apparatus, or cerebral cortex
- Occurs alone or precedes vomiting

!

Severe vomiting can cause fluid and electrolyte imbalances.

APPLIED SCIENTIFIC CONCEPTS (Figure 7.3)

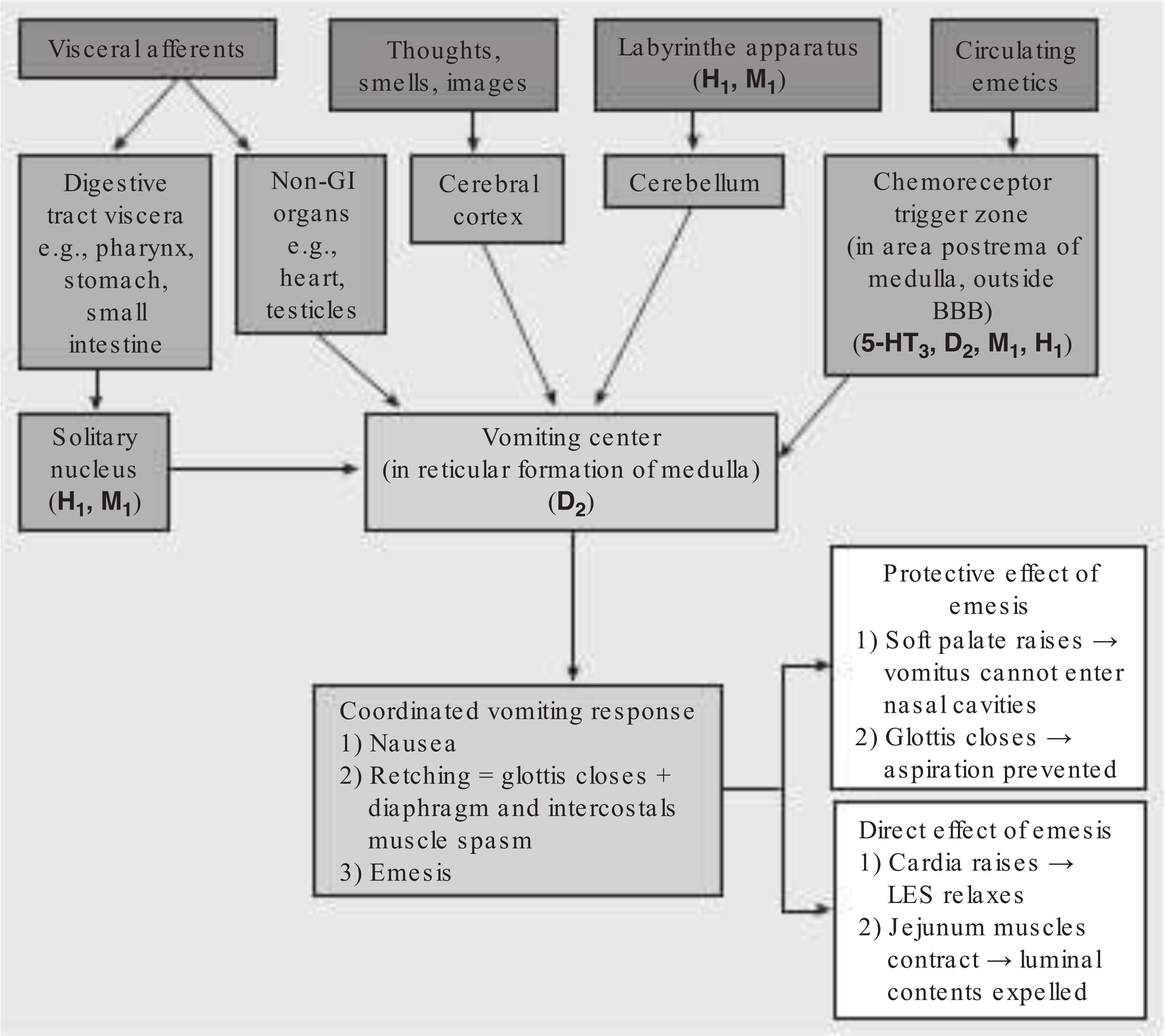

Visceral afferents
Thoughts, smells, images
Labyrinthe apparatus (H_1, M_1)
Circulating emetics
Digestive tract viscera e.g., pharynx, stomach, small intestine
Non-GI organs e.g., heart, testicles
Cerebral cortex
Cerebellum
Chemoreceptor trigger zone (in area postrema of medulla, outside BBB) ($5\text{-}HT_3$, D_2, M_1, H_1)
Solitary nucleus (H_1, M_1)
Vomiting center (in reticular formation of medulla) (D_2)
Protective effect of emesis
1) Soft palate raises → vomitus cannot enter nasal cavities
2) Glottis closes → aspiration prevented
Coordinated vomiting response
1) Nausea
2) Retching = glottis closes + diaphragm and intercostals muscle spasm
3) Emesis
Direct effect of emesis
1) Cardia raises → LES relaxes
2) Jejunum muscles contract → luminal contents expelled

Figure 7.3. Physiology of vomiting.

ASC box

Pharmacologic Interventions in Managing Nausea

- Nausea is mediated by four main neurotransmitters (5-HT$_3$, H$_1$, D$_2$, ACh)
- Vomiting center in medulla oblongata initiates vomiting reflex. Activated by signals from the cerebral cortex, vestibular apparatus, sensory input, and indirectly by the CTZ
- CTZ activated by signals from stomach and small intestine or by emetogenic compounds in blood
- Using receptor blockade medications of the four main neurotransmitters prevents activation of vomiting center.

ASC box

Pharmacologic Rx of Nausea and Vomiting

Drug Class	Drug Example
5-HT$_3$ antagonist	Ondansetron
D$_2$ antagonist	Metoclopramide (crosses BBB, acts at vomiting center) Domperidone (does not cross BBB, acts at CTZ)
H$_1$ antagonist	Diphenhydramine
M$_1$ antagonist	Scopolamine
CB$_1$ agonist	Dronabinol

Adapted with permission from Brunton LL, Lazo JS, Parker KS, eds. Goodman and Gilman's the Pharmacological Basis of Therapeutics. New York, NY: McGraw-Hill; 2006.

CAUSAL CONDITIONS (Table 7.2)

TABLE 7.2 • System-based differential Dx of nausea and vomiting

System		Differential Dx
CNS		• Elevated ICP (infection, tumors) • Vestibular nerve lesion • Brain stem lesion • Psychiatric issue • Migraine
GI	UGI	• Acute gastroenteritis • Gastroparesis / postoperative / nonulcer dyspepsia • Neoplasm • PUD • Gastric outlet obstruction (pyloric stenosis) • GERD
	Lower GI	• Acute infectious enteritis • IBD • Obstruction • Neoplasm • Appendicitis
	Other GI	• Hepatobiliary disease • Acute hepatitis/cholecystitis • Acute pancreatitis • Peritoneal irritation
Endocrine/metabolic		• Diabetes (DKA) • Hypercalcemia • Uremia • Pregnancy
CA		• Paraneoplastic syndrome • Renal cell CA • Ovarian CA • Gastric CA
Systemic		• Sepsis (pyelonephritis, pneumonia) • Acute inferior myocardial infarct • Drugs (opioids, antibiotics, anticonvulsants, chemotherapy) • Food poisoning

CLINICAL box

Causes of Nausea/Vomiting: VOMITING

Vestibular/brainstem lesion
Obstruction
Metabolic/endocrine
Infection and infarction
Trimester 1 of pregnancy
Intracranial pressure
Neoplasm and chemotherapy
GERD

History and Physical Exam

- See Table 7.3

APPROACH (Table 7.3)

TABLE 7.3 • Approach to nausea and vomiting

Etiology	Hx	Physical	Labs/Imaging	Tx
Chemotherapy	CA			Ondansetron, glucocorticoids
Pregnancy	Occurs in morning		b-Human chorionic gonadotropin	Antihistamine

(Continued)

TABLE 7.3 • Continued

Etiology	Hx	Physical	Labs/Imaging	Tx
Drug/toxin (e.g., lithium, digoxin, mushrooms)	Full med and social Hx		Drug screen	Discontinue use if possible, or use central antiemetic
DKA	Diabetes mellitus, polyuria, polydipsia	Fruity breath, abdominal pain, volume depletion	Glucose, serum and urinary ketones, electrolytes	DKA Tx (IVFs and insulin)
↑ ICP	Headache, visual field change, Hx of space-occupying lesion/ hydrocephalus/trauma	Neurologic impairment	Head CT or MRI	Correct underlying condition
Labyrinthe disorder	Vertigo, tinnitus	Neurologic impairment		Correct underlying condition
Delayed GI emptying	Occurs after meals, partially digested food particles, Hx of diabetes or scleroderma, early satiety, weight loss		UGI series/barium, motility studies, endoscopy to rule out structural causes	Prokinetic medications (domperidone, erythromycin, metoclopramide) Feeding tube/TPN
Obstruction	Abdominal distention, pain, inability to pass gas or bowel movements	Absent bowel sounds, acute abdomen, and hemodynamic instability if perforated	Abdominal 3 views/ CT scan	Supportive (NPO, IV fluids, NG decompression) Surgical (OR)
Infection/inflammation	Pain in affected organ	Fever, abdominal guarding	CBC, liver biochemical tests, serum amylase and lipase	Correct underlying condition
Myocardial ischemia	Chest pain	Cardiovascular exam	ECG	Correct underlying condition

Investigations

- General lab tests: CBC, electrolytes, creatinine, urea, glucose, thyroid function tests, liver biochemical tests, serum amylase, and lipase levels
- Specific lab tests: tailor lab tests to clinical suspicions to determine etiology and specific Rx
- Imaging: AXR; may consider CT abdomen if evidence of obstruction or CT head if concern of increased intracranial pressure

Management

Manage the combined fluid and electrolyte depletion that may occur following vomiting by:

- Volume assessment by evaluation of jugular venous pressure, vitals, skin turgor, mucous membranes, hypotension, and orthostatic changes
- Restore volume depletion by administration of isotonic normal saline
- Evaluation of Na^+, Cl^-, HCO_3^-, and K^+ and correction through appropriate replacement

Nonpharmacologic Treatment

- Eliminate strong smells and environmental triggers for nausea
- Small, frequent, bland meals
- Avoid lying flat after eating
- Avoid spicy and fatty foods
- Good oral hygiene especially after vomiting

Diagnosis

- Investigations based on Hx, physical exam, and probable cause of symptoms
- See Table 7.3 for workup of specific entities causing nausea and vomiting

CLINICAL box

$DNa^+ = (140 - PNa) \times TBW$

$DNa^+ =$ Sodium deficit (in mEq/L)

$PNa^+ =$ Plasma sodium concentration

$TBW =$ Total body water (in L, ↓ if dehydrated)

CHRONIC ABDOMINAL PAIN

MCC OBJECTIVE

Based on Objective #3-3 (Chronic Abdominal Pain) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Constant or intermittent pain over at least 3 to 6 mo. Is a common complaint in 20% to 40% of adults.
- Distinguish organic from functional pain by Hx and physical exams.

CAUSAL CONDITIONS

History (Table 7.4)

TABLE 7.4 • Differential Dx of chronic abdominal pain by quadrant

			Pathology	
		System	Organic	Functional
Upper quadrants	Dyspepsia/epigastric	Bowel disease	• PUD • GERD • Gastric CA	• Non-ulcer dyspepsia
		Pancreatic disease	• Chronic pancreatitis • Pancreatic CA	
	RUQ	Biliary disease	• Biliary colic/choledocholithiasis • Chronic cholecystitis	• Sphincter of Oddi dysfunction
		Hepatic disease	• Hepatomegaly (fat infiltration/granuloma/congestion) • Malignancy (primary or secondary)	
Lower quadrants		Bowel disease	• Crohn disease (right) • UC • Diverticulitis (left)	• IBS
		Genitourinary disease	• Endometriosis • Ovarian cyst/torsion	• Spastic bladder, recurrent UTI
		Hernia	• Inguinal • Femoral	
Diffuse/local pain			• Lymphomas/neoplasms (e.g., spinal cord) • Diabetes mellitus • Chronic uremia • Degenerative disc disease	• Lactose intolerance • Abdominal wall injury • Somatization

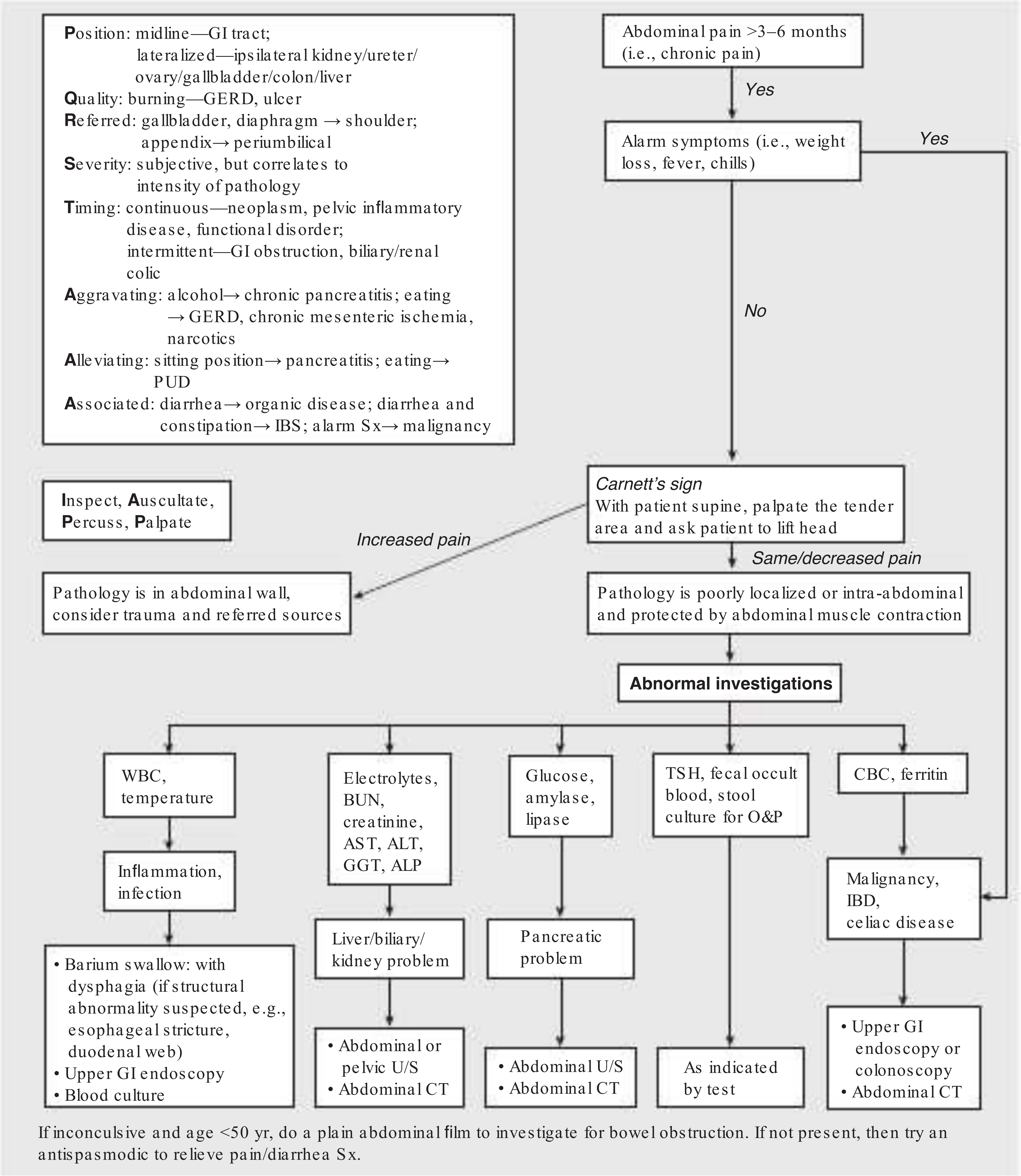
Physical exam

- See Table 7.4

APPROACH (Figure 7.4)

Investigations

- Investigations should be done based on history, physical exam, and medical Hx.
- Further imaging such as AXR, CT of abdomen, or upper GI endoscopy/colonoscopy may be required.
- If inconclusive and age < 50 yr, do a plain abdominal film to investigate for bowel obstruction. If not present, then try an antispasmodic to relieve pain/diarrhea Sx.


Position: midline—GI tract; lateralized—ipsilateral kidney/ureter/ovary/gallbladder/colon/liver
Quality: burning—GERD, ulcer
Referred: gallbladder, diaphragm → shoulder; appendix→ periumbilical
Severity: subjective, but correlates to intensity of pathology
Timing: continuous—neoplasm, pelvic inflammatory disease, functional disorder; intermittent—GI obstruction, biliary/renal colic
Aggravating: alcohol→ chronic pancreatitis; eating → GERD, chronic mesenteric ischemia, narcotics
Alleviating: sitting position→ pancreatitis; eating→ PUD
Associated: diarrhea→ organic disease; diarrhea and constipation→ IBS; alarm Sx→ malignancy
Inspect, Auscultate, Percuss, Palpate
Abdominal pain >3–6 months (i.e., chronic pain)
Yes
Alarm symptoms (i.e., weight loss, fever, chills)
Yes
No
Carnett's sign
With patient supine, palpate the tender area and ask patient to lift head
Increased pain
Pathology is in abdominal wall, consider trauma and referred sources
Same/decreased pain
Pathology is poorly localized or intra-abdominal and protected by abdominal muscle contraction
Abnormal investigations
WBC, temperature
Electrolytes, BUN, creatinine, AST, ALT, GGT, ALP
Glucose, amylase, lipase
TSH, fecal occult blood, stool culture for O&P
CBC, ferritin
Inflammation, infection
Liver/biliary/kidney problem
Pancreatic problem
Malignancy, IBD, celiac disease
• Barium swallow: with dysphagia (if structural abnormality suspected, e.g., esophageal stricture, duodenal web)
• Upper GI endoscopy
• Blood culture
• Abdominal or pelvic U/S
• Abdominal CT
• Abdominal U/S
• Abdominal CT
As indicated by test
• Upper GI endoscopy or colonoscopy
• Abdominal CT

If inconclusive and age <50 yr, do a plain abdominal film to investigate for bowel obstruction. If not present, then try an antispasmodic to relieve pain/diarrhea Sx.

Figure 7.4. Approach to chronic abdominal pain.

Diagnosis

- Making a diagnosis is based on Hx, physical, and appropriate testing.
- If Hx/physical exam does not suggest an organic pathology and routine laboratory tests are normal, consider functional cause of abdominal pain.

Management

- **Nutritional:** increase fiber and try lactose-free diet. Limit aggravating foods (e.g., fatty food, chocolate, mint)

- **Psychological:** stress therapy (e.g., relaxation techniques, biofeedback, abdominal breathing)
- **Patient education:** if pain is nonorganic, reassure that disease is benign and will not alter life expectancy
- **Medications and surgical:** tailor to specific etiology
- Narcotics
  - **Initial:** consider short-term hospitalization, NPO, short-acting opiates, NSAIDs, amitriptyline
  - **Maintenance:** long-acting opiates if pain is persistently severe
  - **Complications:** constipation (use fiber supplement, laxative)

GERD versus PUD (Table 7.5)

TABLE 7.5 • GERD versus PUD

	GERD	PUD
Pathophysiology	1. Hypotensive lower esophageal sphincter (LES) 2. Transient LES relaxation 3. Hiatus hernia 4. Decreased esophageal peristalsis	1. H. pylori infection 2. Iatrogenic (NSAIDs, anti-Plt drugs) 3. Other (a growing population are developing ulcers unrelated to H. pylori or NSAIDs)
Treatment	1. Lifestyle: elevate head of bed, ↑ salivation to neutralize acid (chew gum, stop smoking/drinking, avoid high-fat, spicy meals) 2. Med: ↓ acid production (PPI or H_2RA), ↑ LES tone (cisapride) 3. Surgical: reduce hiatus hernia, ↑ LES tone by fundoplication	1. Eradicate H. pylori (antibiotics) 2. Discontinue NSAIDs if possible 3. ↓ Acid production (PPI or H_2RA)

BLOOD FROM GI TRACT

MCC OBJECTIVE

Based on Objective #6-1 (Upper Gastrointestinal Bleeding) and Objective #6-2 (Lower Gastrointestinal Bleeding) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- UGI bleed usually manifests as **hematemesis** (vomiting blood or coffee-ground material) and/or **melena** (black, tarry stools)
- Lower GI bleed usually manifests as **hematochezia** (bright red blood or dark red blood or clots PR)
- **Occult GI bleed** (i.e., normal stool color) may be suggested by positive commercial fecal occult blood tests (e.g., **Guaiac smear test**) for occult blood or presence of iron-deficiency anemia

CAUSAL CONDITIONS (Table 7.6)

TABLE 7.6 • Upper versus lower GI bleed

Hematemesis	• **See upper GI bleed**
Melena	• UGI bleed • Consider possibility of slow transit lower GI bleed (seen in 5%–10%)
Hematochezia/bright red	• **See lower GI bleed** • Left colon (75% colon, 20% UGI/small intestine) • Consider possibility of massive and vigorous UGI bleed
Dark red, mixed with stool	• Right colon

HEMATEMESIS

MCC OBJECTIVE

Based on Objective #6-1 (Upper Gastrointestinal Bleeding) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- UGI bleed defined as blood originating proximal to ligament of Treitz (duodenal–jejunal junction)
- May result in hematemesis, melena (requires > 50 mL of blood), and/or hematochezia (vigorous UGI bleed)
- Requires urgent workup and Rx; can be self-limited
- Urgency and type of resuscitation dependent on total blood loss, cause of bleeding, and presence of any comorbidity

APPLIED SCIENTIFIC CONCEPTS (Figure 7.5)

Pathophysiology of *H. pylori* infection

- Specific adherence to gastric epithelium through bacterial **adhesins** (does not invade systemically); disrupt mucous layer
- Liberates enzymes/toxins such as urease, phospholipases, catalase, lipopolysaccharides
- Pathogenesis: host immune response → chronic inflammation and acid peptic damage (inflammatory cytokines such as IL-1, IL-6, IL-**8**, TNF-a) and antibody response (IgA and IgG to CagA that activate complement and neutrophils) → chronic gastritis
- Progression: (1) ASx, (2) PUD, (3) atrophic gastritis, (4) intestinal metaplasia/gastric CA, (5) gastric lymphoma

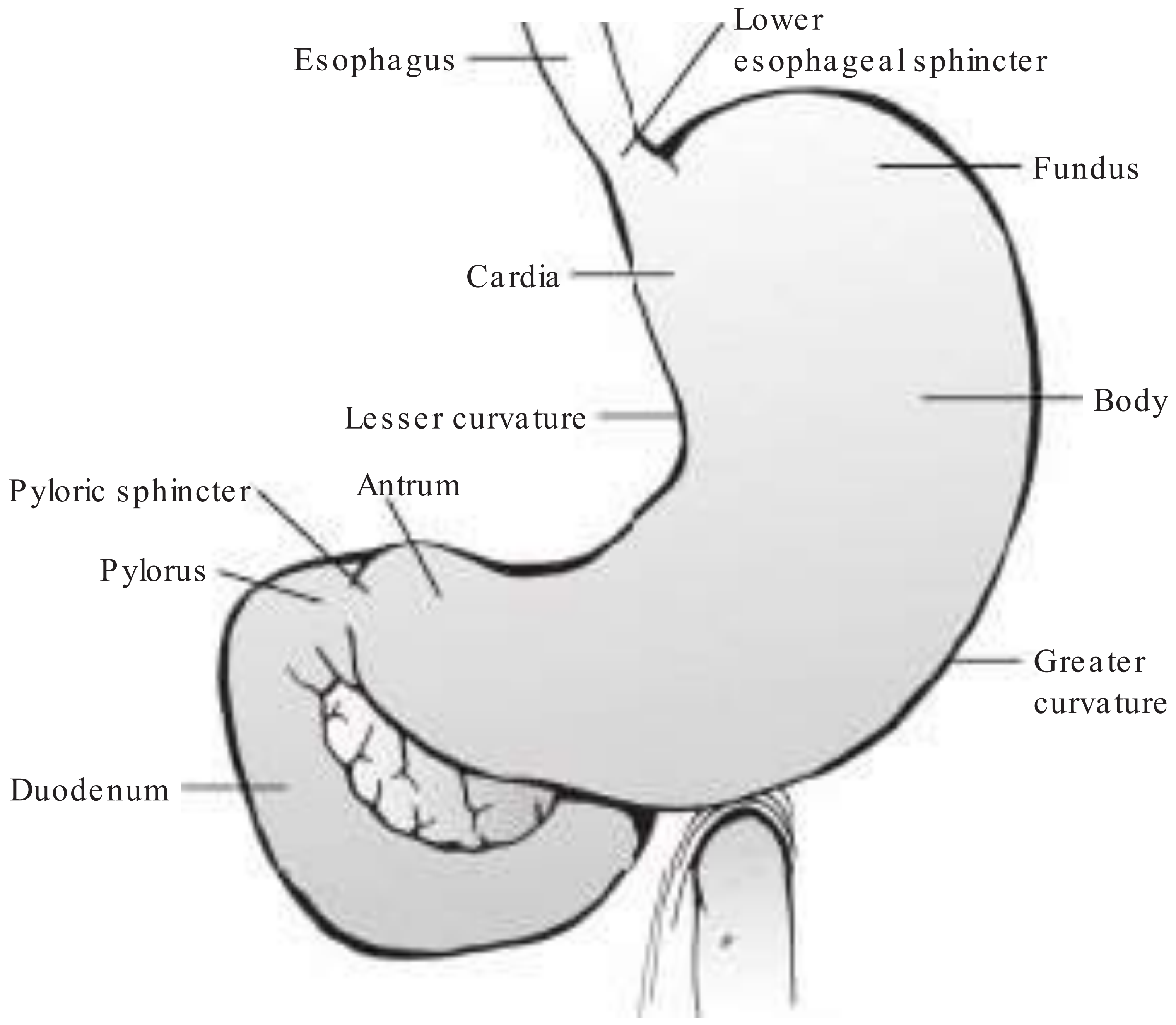


Figure 7.5. Normal gastric anatomy.

Normal Gastric Histology and Function (Table 7.7)

TABLE 7.7 • Normal gastric histology and function

	Anatomic Location	Secretions
Mucous surface cells (goblet cells)	Surface simple columnar layer	Secrete mucus
Mucous neck cells	Line upper walls of gastric glands	Secrete mucus
Parietal (oxyntic) cells	Scattered along neck and lower walls of gastric glands mainly in fundus/body	Secrete HCl and intrinsic factor
Chief (peptic or zymogen) cells	Line lower walls of gastric glands mainly in fundus/body	Secrete pepsinogen
Enteroendocrine cells (i.e., G cells)	Located mainly in antrum/pylorus	Secrete hormones such as **gastrin**

Effects of NSAIDs on Gastric Physiology (Table 7.8)

TABLE 7.8 • Effects of NSAIDs on gastric physiology

Cox-I Independent	Cox-I Dependent (Direct Topical Effect)

• PGE_2 (↓ GI mucosal protection)
  • ↓ Gastric mucosal blood flow
  • ↓ Mucous secretion
  • ↓ Stabilization of cell membranes and tight junctions
  • ↓ Duodenal HCO_3- secretion
  • ↑ Gastric acid secretion
• Thromboxane A_2 (↓ Plt adhesiveness/hemostasis)
	• NSAIDs are weak organic acids that become trapped in gastric mucosal epithelial cells and build up to cause local toxic effects.
	• ↑ glutathione to scavenge superoxide radicals (anticarcinogenic)

CAUSAL CONDITIONS (Table 7.9)

TABLE 7.9 • Differential Dx of UGI bleed

Mechanism	Causes (Incidence)

Ulcerative/erosive	• PUD (esophageal vs. gastric vs. duodenal) (55%)
	• Infectious (H. pylori)
	• Drugs (NSAIDs)
	• Stress ulcer
	  • Cushing ulcer: associated with ↑ ICP
	  • Curling ulcer: associated with severe burns or other severe physiologic stress
	• Zollinger-Ellison syndrome (hypersecretion of gastrin from gastrinoma)
	• Nonulcerative esophagitis/gastritis
	  • Peptic
	  • Infectious
	  • Drugs

Portal HTN	• Varices (15%)
	  • Esophageal
	  • Gastric
	  • Duodenal

Trauma/postsurgery	• Mallory-Weiss tear (5%) • Boerhaave syndrome • Aortoenteric fistula

(Continued)

CLINICAL box

Differential Dx of UGI Bleed: GUM BLEEDING

Gastritis
Ulcer
Mallory-Weiss
Biliary (hemobilia)
Large varices
Esophageal ulcer/esophagitis/esophageal varices
Enteroaortic fistula (aortic graft)
Duodenitis/drugs (NSAIDs)
Inflammatory bowel disease
Neovascularization (AVM)
Gastric CA

CLINICAL box

Causes of Black Stool that May Mimic Melena

- Bismuth subsalicylate (Pepto-Bismol)
- Iron
- Charcoal
- Spinach
- Licorice

Table 7.9 • Continued

Mechanism	Causes (Incidence)
Tumor (5%)	• Benign • Malignant
Vascular malformation	• Angioma • Dieulafoy lesions (small ectatic arterial malformations)
Hepatobiliary	• Hemobilia • Neoplasia • Biliary inflammation • Hepatic artery aneurysm • Iatrogenic (i.e., complication of core liver biopsy)
Non-GI	• Epistaxis • Hemoptysis

APPROACH (Figure 7.6)

History

- Volume of hematemesis
- Medications (NSAIDs, anticoagulants)
- Medical Hx (liver cirrhosis/varices, renal failure, melena, hematochezia, metastatic CA)

Physical exam

- Sinus tachycardia, postural hypotension
- Anemia (pallor)
- Stigmata of chronic liver disease
- Rectal exam

Risk Factors

- EtOH, cigarettes, aspirin/NSAIDs, anticoagulants (e.g., warfarin), steroids, trauma, vomiting, Hx of UGI bleed, Hx of PUD, liver disease, esophageal varices, portal HTN, splenic vein thrombosis, AAA repair (aortoenteric fistula), burns

Lab Tests

- CBC, type and cross, electrolytes, creatinine, liver enzymes, albumin, bilirubin, amylase, PT/INR/aPTT
- Imaging: CXR, AXR

Diagnosis

- Hx and physical exam will help determine cause of upper GI bleed.
- EGD for determining cause and for therapy in certain situations
- May require angiogram and/or surgical consult if unable to visualize and treat cause endoscopically

High Risk Criteria for Rebleed

- Old age
- Comorbid conditions
- Clinical evidence of aggressive bleed
- Ulcer size (> 2 cm)
- Onset of bleeding in hospital
- Diagnostic appearance:
  - Ulcer base with recent, adherent clot (25%–30% chance)
  - Ulcer base with visible vessel (50% chance)
  - Ulcer base with blood oozing or spurting (90% chance)

Management

Mechanism of selected drugs in GI bleeding (Table 7.10)

PUD

- Pharmacologic Rx: *H. pylori* eradication, continued PPI or H_2RA
- Stop NSAID, anticoagulant, EtOH ingestion

CLINICAL box

UGI Bleed Outcomes

- 80% to 85% of patients spontaneously stop bleeding.
- Overall 10% mortality rate from acute UGI bleed

CLINICAL box

H. pylori **Rx (10–14 d)**

- PPI triple Rx
  - PPI (i.e., omeprazole 20 mg b.i.d.)
  - Amoxicillin, 1,000 mg b.i.d. or metronidazole, 500 mg b.i.d.
  - Clarithromycin, 500 mg b.i.d.
- Quadruple Rx
  - PPI (i.e., omeprazole 20 mg b.i.d.)
  - Bismuth, 2 tab q.i.d.
  - Metronidazole, 250 mg t.i.d.
  - Tetracycline, 500 mg q.i.d.

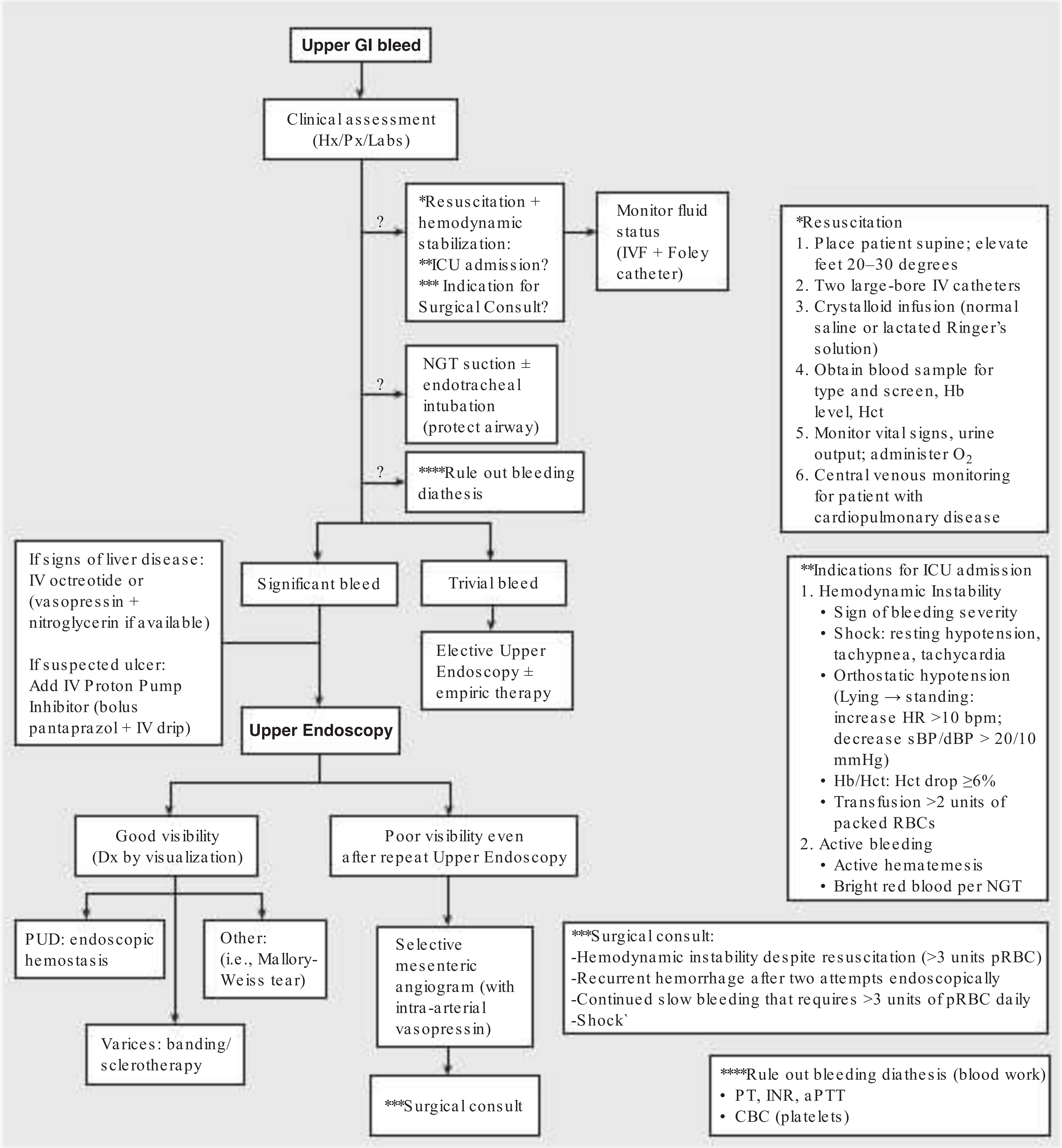

Upper GI bleed
Clinical assessment (Hx/Px/Labs)
?
*Resuscitation + hemodynamic stabilization:
**ICU admission?
*** Indication for Surgical Consult?
Monitor fluid status (IVF + Foley catheter)
?
NGT suction ± endotracheal intubation (protect airway)
?
****Rule out bleeding diathesis
*Resuscitation
1. Place patient supine; elevate feet 20–30 degrees
2. Two large-bore IV catheters
3. Crystalloid infusion (normal saline or lactated Ringer's solution)
4. Obtain blood sample for type and screen, Hb level, Hct
5. Monitor vital signs, urine output; administer O2
6. Central venous monitoring for patient with cardiopulmonary disease
If signs of liver disease: IV octreotide or (vasopressin + nitroglycerin if available)
If suspected ulcer: Add IV Proton Pump Inhibitor (bolus pantaprazol + IV drip)
Significant bleed
Trivial bleed
Elective Upper Endoscopy ± empiric therapy
Upper Endoscopy
**Indications for ICU admission
1. Hemodynamic Instability
• Sign of bleeding severity
• Shock: resting hypotension, tachypnea, tachycardia
• Orthostatic hypotension (Lying → standing: increase HR >10 bpm; decrease sBP/dBP > 20/10 mmHg)
• Hb/Hct: Hct drop ≥6%
• Transfusion >2 units of packed RBCs
2. Active bleeding
• Active hematemesis
• Bright red blood per NGT
Good visibility (Dx by visualization)
Poor visibility even after repeat Upper Endoscopy
PUD: endoscopic hemostasis
Other: (i.e., Mallory-Weiss tear)
Varices: banding/ sclerotherapy
Selective mesenteric angiogram (with intra-arterial vasopressin)
***Surgical consult
***Surgical consult:
-Hemodynamic instability despite resuscitation (>3 units pRBC)
-Recurrent hemorrhage after two attempts endoscopically
-Continued slow bleeding that requires >3 units of pRBC daily
-Shock`
****Rule out bleeding diathesis (blood work)
• PT, INR, aPTT
• CBC (platelets)

Figure 7.6. Approach to UGI bleed.

Table 7.10 • Mechanism of selected drugs in GI bleed

Octreotide	↓ Portal pressure by inhibiting vasoactive peptides such as substance P and glucagon and ↓ splanchnic blood flow in treating variceal hemorrhage
PPI (i.e., omeprazole)	Inhibits gastric H^+/K^+ pump, resulting in ↓ gastric acid secretion
H_2RA (i.e., ranitidine)	Blocks H_2 receptor on parietal cells to ↓ gastric acid secretion; first-line Rx for GERD
IV Erythromycin	Prokinetic effect to decrease amount of blood in stomach. When given prior to endoscopy may decrease need for repeat EGD to determine site of bleeding.

- Endoscopic Rx:
  - Injection: saline and epinephrine
  - Coagulative diathermy: bipolar or multipolar electrocoagulation; heater probe
  - Hemoclips
  - Radiologic arterial embolization
  - Surgery for refractory bleeding: oversewing of bleeding site; resection of ulcer

Esophageal Varices

- Pharmacologic Rx (in acute setting only): somatostatin/octreotide for 3 to 5 d
- Sengstaken-Blakemore balloon: compression
- Endoscopic Rx:
  - Sclerotherapy
  - Rubber band ligation
  - TIPS
  - Surgical decompressive portal-systemic shunt
  - Liver transplant
- Once stable, consider nonselective b-blocker (e.g., nadolol 40 mg daily)

Mallory-Weiss Tear

- Endoscopic injection of saline and epinephrine
- Endoscopic thermal electrocautery
- Radiologic arterial embolization
- Surgery: refractory bleed

Stress Ulcer Prophylaxis

- PPI (PO recommendation)
- H_2RA (IV recommendation)
- Antacids
- Sucralfate
- PG analog
- Enteral nutrition or TPN

HEMATOCHEZIA

MCC OBJECTIVE

Based on Objective #6-2 (Lower Gastrointestinal Bleeding) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Blood originating distal to ligament of Treitz (duodenal–jejunal junction)
- May result in melena and/or hematochezia
- Lower GI bleed < UGI bleed (20% vs. 80%)
- Affects mainly elderly patients (10%–20% morbidity/mortality)

!

Critical to have early identification of colorectal CA (second most common cause of CA-related mortality after lung CA)

CAUSAL CONDITIONS (Table 7.11)

APPROACH (Figure 7.7)

Screening for Colorectal CA (Table 7.12)

- ASx without first-degree family Hx (average risk)
  - Consider colonoscopy at 50 yr
  - Alternatives to colonoscopy for screening:
    - Fecal occult blood test every 2 yr
    - Flexible sigmoidoscopy every 5 yr
    - Double contrast barium enema every 5 yr
    - CT colonography every 5 yr
- ASx with first-degree relative with CA or adenomatous polyp at age < 60 yr
  - Colonoscopy starting at age 40 or 10 yr earlier than youngest diagnosis of CA/adenomatous polyp in family. Start at whatever age comes first.

CLINICAL box

Limitations of Fecal Occult Blood Testing as a Screen for Colorectal CA

- Relatively low sensitivity (35%–80%)
- Relatively low specificity (i.e., does not indicate etiology at all)
- High false-positive and false-negative rate
- Poor participation and compliance after positive test
- Lack of follow-up by physicians

History

- Melena, characterize amount of blood, mixed in with stool versus on top of stool
- Abdominal pain

- Weight change, constitutional symptoms
- Medical Hx
- Medications (NSAIDs, anticoagulants)
- Family Hx of colon CA

Table 7.11 • Differential Dx of lower GI bleed

Mechanism	Causes (Incidence)
Diverticulosis (40%)	• Mostly right colon; most common cause of massive lower GI bleed (painless)
Angiodysplasia (25%)	• May be anywhere in small or large intestine
Other	• Anorectal disease (< 50 yr) ◦ Hemorrhoids ◦ Fissures • Colorectal CA/polyps (if > 50 yr, 10%–20%) • Enterocolitis ◦ Ischemia ◦ Infectious (Salmonella, Shigella, Campylobacter) ◦ IBD • Radiation colitis • Other ◦ Small bowel neoplasms/ulcers ◦ Meckel diverticulum ◦ Traumatic rectal injuries • Brisk upper GI bleed
Tumor (5%)	• Benign • Malignant
Vascular malformation	• Angioma • Dieulafoy lesions (small ectatic arterial malformations)
Hepatobiliary	• Hemobilia • Neoplasia • Biliary inflammation • Hepatic artery aneurysm • Iatrogenic (i.e., complication of core liver biopsy)

Physical exam

- Assess for tachycardia, orthostatic vitals, hypotension
- Evidence of anemia/pallor
- Abdominal tenderness
- Digital rectal exam

Investigations

- CBC, type and cross, electrolytes, creatinine, urea, PT/INR/aPTT, stool cultures
- Acute bleed: assess vital signs, check CBC, type and cross in anticipation of immediate or future blood transfusion
- Chronic bleed: confirm that patient is hemodynamically stable, assess hemoglobin, MCV, and iron studies, consider specialty referral for definitive Dx and Rx
- Radiologic imaging versus angiography (Table 7.13)

Diagnosis

- Hx and physical exam will help determine cause of lower GI bleed
- Upper GI endoscopy if brisk upper bleed is suspected, otherwise colonoscopy
- If obscure bleeding cause, consider angiography or RBC scan

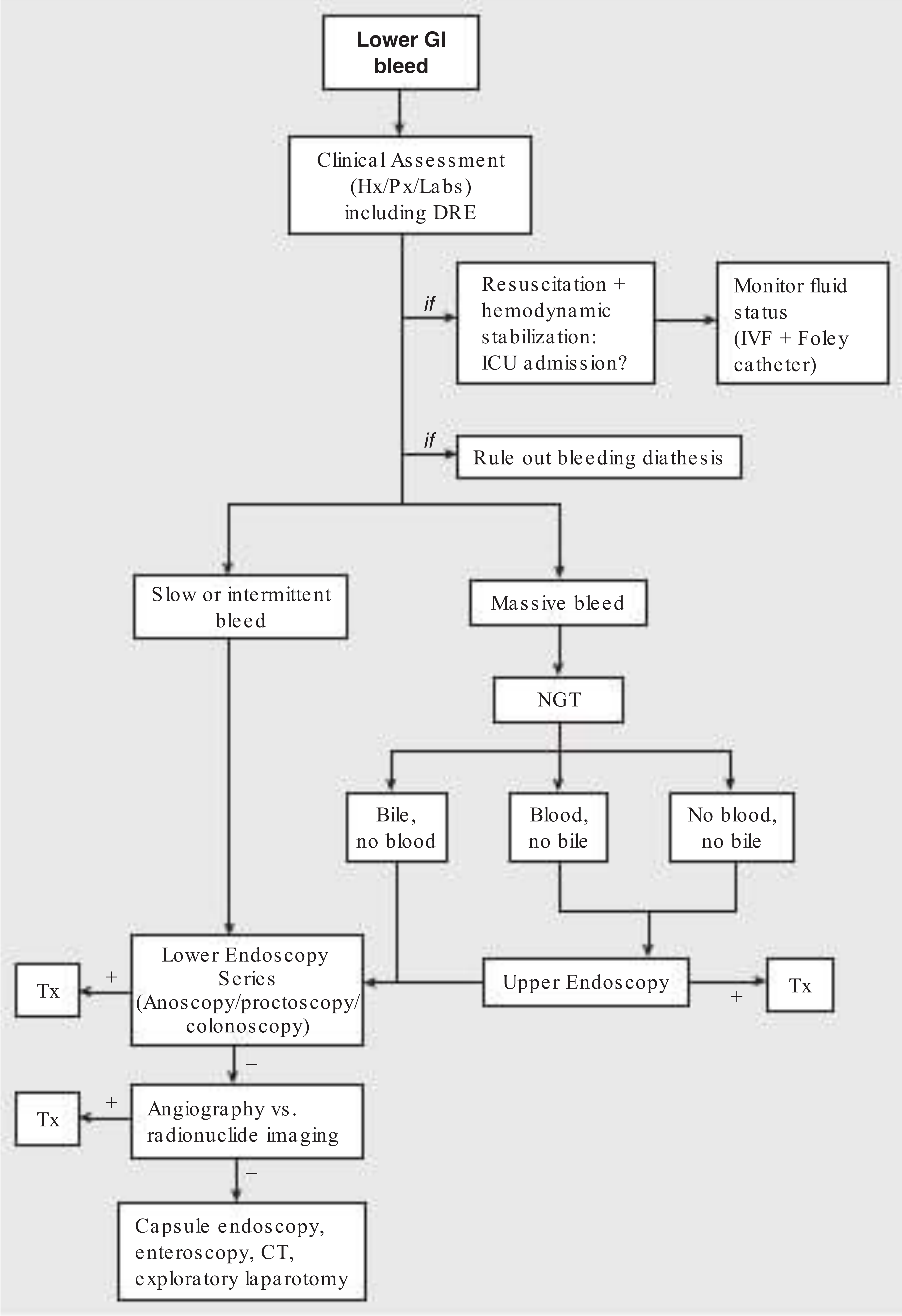

Lower GI bleed
Clinical Assessment (Hx/Px/Labs) including DRE
if
Resuscitation + hemodynamic stabilization: ICU admission?
Monitor fluid status (IVF + Foley catheter)
if
Rule out bleeding diathesis
Slow or intermittent bleed
Massive bleed
NGT
Bile, no blood
Blood, no bile
No blood, no bile
Lower Endoscopy Series (Anoscopy/proctoscopy/colonoscopy)
Upper Endoscopy
Tx
+
Tx
+
–
Angiography vs. radionuclide imaging
Tx
+
–
Capsule endoscopy, enteroscopy, CT, exploratory laparotomy

Figure 7.7. Approach to lower GI bleed.

TABLE 7.12 • Risk factors for colorectal CA and diverticulosis

Colorectal CA	Diverticulosis
• Polyps • Familial adenomatous polyposis • Hereditary nonpolyposis colorectal cancer (Lynch syndrome) • IBD: UC > Crohn's • Previous colorectal CA, breast CA • Diet: low-fiber, high-fat • Old age • Family Hx	• Chronic constipation • CT disorders (i.e., Marfan syndrome) • Meds: corticosteroids, NSAIDs

TABLE 7.13 • Radiologic imaging versus angiography

	Radiologic Imaging	Angiography
Detection limit	• Bleeding at the rate of 0.1–0.5 mL/min	• Bleeding at the rate of 1.0–1.5 mL/min
Sensitivity and specificity	• More sensitive than angiography • Less specific than angiography, colonoscopy	• 100% specific, poor sensitivity
Advantages	• Noninvasive • Sensitivity • Can repeat scan regularly	• No bowel prep • Accurate localization • Therapeutic intervention (intra-arterial vasopressin)
Disadvantages	• Poor localization • Only localize to abdominal area	• Complications: • Arterial thrombosis embolization • Renal failure
Types	• 99mTc sulfur colloid • 99mTc pertechnetate-labeled autologous RBCs	
Recommended for	• After colonoscopy • Before angiography to confirm presence of bleeding and/or location	• After colonoscopy

Management

- **Immediate Rx:** two large-bore IVs for resuscitation with normal saline or transfusion of packed red cells as needed
- **Med Rx:**
  - Mild/moderate IBD: mesalamine suppository/enema, sulfasalazine, corticosteroids
  - Severe IBD: corticosteroids, cyclosporine, infliximab
  - Ischemic colitis: conservative Rx; consider surgery as last resort
  - Infectious colitis: antibiotics
- **Endoscopic Rx:** laser, electrocoagulation, local epinephrine injection (rare situations, usually diagnostic only)
- **Consider angiography Rx:** intra-arterial vasopressin (vasoconstriction), selective arterial embolization (e.g., coils, Gelfoam) for acute lower GI bleed
- Surgery
  - Bleeding site known: segmental resection of bowel
  - Bleeding site unknown: exploratory laparotomy ± total abdominal colectomy (ileorectostomy)

CLINICAL box

Outcomes of GI Bleeding

- 80% to 90% of lower GI bleeding stop spontaneously with resuscitation.
- 10% of patients require surgery (consider risks of emergent and non-emergent surgery).

ACUTE DIARRHEA

MCC OBJECTIVE

Based on Objective #22-1 (Acute Diarrhea) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Diarrhea (Table 7.14) is very common worldwide; morbidity and mortality are significant, even in North America.
- Most acute episodes of diarrhea are self-limited; only a minority will require further testing and treatment.

CAUSAL CONDITIONS (Table 7.15)

- The etiology of acute diarrhea can be broken down into infectious versus noninfectious (including osmotic)

TABLE 7.14 • Definitions of diarrhea

Acute	> 2 d, ≤ 2 wk > 3 stools/d or > 200 g stools/d, likely infectious etiology
Persistent	> 2 wk
Chronic	> 4 wk, likely noninfectious etiology
Pseudodiarrhea	↑ Frequency, normal consistency, normal stool weight (i.e., thyrotoxicosis, acute IBS-like episodes, proctitis, neurologic impairment, impaction)

TABLE 7.15 • Differential Dx of acute diarrhea

Major Causes		
Infectious	Diarrhea predominant	Small bowel Bacteria (i.e., C. perfringens, V. cholera, E. coli, Salmonella, Yersinia)[a] Viruses (i.e., Norovirus/Norwalk, rotavirus)[b] Parasites (i.e., Giardia) Drugs, toxins Large bowel Bacteria (i.e., Shigella, Campylobacter, E. coli 0157:H7, Salmonella, C. difficile)[a]
	Nausea/vomit predominant	Bacteria (i.e., B. cereus, S. aureus)
Drugs	Antibiotics (C. difficile negative), digoxin, laxatives	
Food/additives	Lactose intolerance (e.g., dairy products) Sorbitol (osmotic)	
Inflammatory	IBD (ulcerative colitis, Crohn's) Ischemic	
Metabolic	Hyperthyroidism	

[a] Majority of severe acute diarrhea.

[b] Majority of self-limited acute diarrhea.

CLINICAL box

Timing of Onset

1. < 6 h: preformed toxin (S. aureus, B. cereus)
2. 8 to 16 h: C. perfringens
3. > 16 h: bacterial or viral

CLINICAL box

Public Health notification

- Patient's occupation involves food handling, day cares, direct patient contact.
- When a public food service facility is identified as the potential cause
- Patient is suspected to be part of a community outbreak.

CLINICAL box

Signs of Volume Depletion

- ↓ Skin turgor
- Orthostatic hypotension
- Tachycardia
- Diaphoresis
- Vasoconstriction (↓ pulse pressure with ↑ diastolic pressure)
- Altered mental status

APPROACH

History

- Onset, duration, frequency
- Stool characteristics
- Fever
- Med Hx (including prescription and OTC meds)
- Dietary Hx, that is, unpasteurized/pasteurized dairy products and chicken/meat/fish and shellfish (e.g., cooked, uncooked, meals prepared in a restaurant, social gathering, etc.)
- Exposure, that is, occupation, travel, pets, hobbies, sexual partners (e.g., fecal-oral route of infectious transmission, HIV risk factors etc.), other known individuals afflicted (i.e., may point to common-source infectious outbreak)

Physical exam

- Signs of volume depletion
- Abdominal exam: peritoneal signs
- Altered level of consciousness

Diagnosis

- In majority of cases, given self-limited nature, no specific diagnosis is made, likely infectious etiology
- Response to stopping potential offending agent suggests that is the culprit

- Cultures and endoscopy may point to specific organism
- Identifying the acute presentation of an issue causing chronic diarrhea is made through further testing (Table 7.16)

TABLE 7.16 • Investigations for acute diarrhea

Test	Rationale
CBC with differential, electrolytes, creatinine	—
Abdominal x-ray	—
Fecal leukocytes or lactoferrin assay	• Test for inflammatory process
Fecal occult blood test	• Test for inflammatory process
ELISA for C. difficile toxins A and B	• Previous antibiotic use, nosocomial infection
Stool culture for bacteria	• Routine: Shigella, Campylobacter, Salmonella, E. coli 0157:H7, Aeromonas, Yersinia (traveler's diarrhea) • Special: Listeria, Vibrio
O&P—three specimens at least 24 h apart	• Generally not cost-effective without clinical suspicion • Routine: Giardia, Cryptosporidium, E. histolytica, Cyclospora
Proctoscopy or flexible sigmoidoscopy ± mucosal biopsy	• Uncommonly used in acute setting • Visually distinguish infectious diarrhea from IBD

Investigations

- See Table 7.16

Management

- If meds/food additives (e.g., dairy products in lactose intolerance, sorbitol, etc.) are suspected cause, discontinue and observe
- General diet recommendations
  - Anorexic: short period of liquids consumption only
  - Starches, grains, bananas, soup, boiled vegetables, salt

Volume Repletion as Appropriate

- Oral rehydration
  - Contains NaCl, KCl, glucose or sucrose, trisodium citrate, or $NaHCO_3$
  - Reduces hospitalization, easy to administer, but difficult to monitor absorption
- IV rehydration
  - Easy to monitor absorption, but requires hospitalization
- Vitamin and mineral repletion
- Symptomatic Rx
  - Patient with no fever, nonbloody diarrhea: antimotility agent such as loperamide (Imodium)
  - Bismuth subsalicylate (Pepto-Bismol)
  - Diphenoxylate (Lomotil)
- Probiotics
- Referral to a gastroenterologist if diarrhea persists and lab tests are negative

CHRONIC DIARRHEA

MCC OBJECTIVE

Based on Objective #22-2 (Chronic Diarrhea) of *Objectives for the Qualifying Examination*, 3rd edition.

CLINICAL box

Bacterial versus Viral

Bacterial → ↑ WBC, left shift, neutropenia in salmonellosis

Viral → normal WBC differential or lymphocytosis

CLINICAL box

Indications for O&P Testing

- Persistent diarrhea
- Travel, especially mountainous regions
- Exposure to infant day care
- AIDS
- Waterborne outbreak
- Bloody diarrhea with few leukocytes → amebiasis

CLINICAL box

Criteria for Further Diagnostic Evaluation

One or more of the following:

- Watery diarrhea with signs of dehydration or volume depletion
- Stools containing blood and/or mucus
- Fever with temperature > 38.5°C
- > 6 unformed stools/d for > 2 d
- Severe abdominal pain with age > 50 yr
- Recent antibiotic use or hospitalized patient
- Age > 70 yr or immunocompromised
- Systemic ileus with diarrhea
- Pregnant women (listeriosis)

CLINICAL box

Antibiotic rx (for Infectious Etiology)

- Generally not required
- Diarrhea is usually self-limited and should be avoided in E. coli 0157:H7
- Indication: traveler's diarrhea, invasive bacterial (fever, blood), hospitalization, elderly, immunocompromised
- Empiric Rx for traveler's diarrhea:
  - Fluoroquinolone (i.e., ciprofloxacin 750 mg daily × 1–3 d)
  - Azithromycin 1,000 mg PO once
  - Rifaximin 200 mg PO t.i.d. × 3 d

OVERVIEW

- Decreased fecal consistency for > 4 wk, likely noninfectious etiology
- Affects approximately 5% of the population

APPLIED SCIENTIFIC CONCEPTS (Figure 7.8)

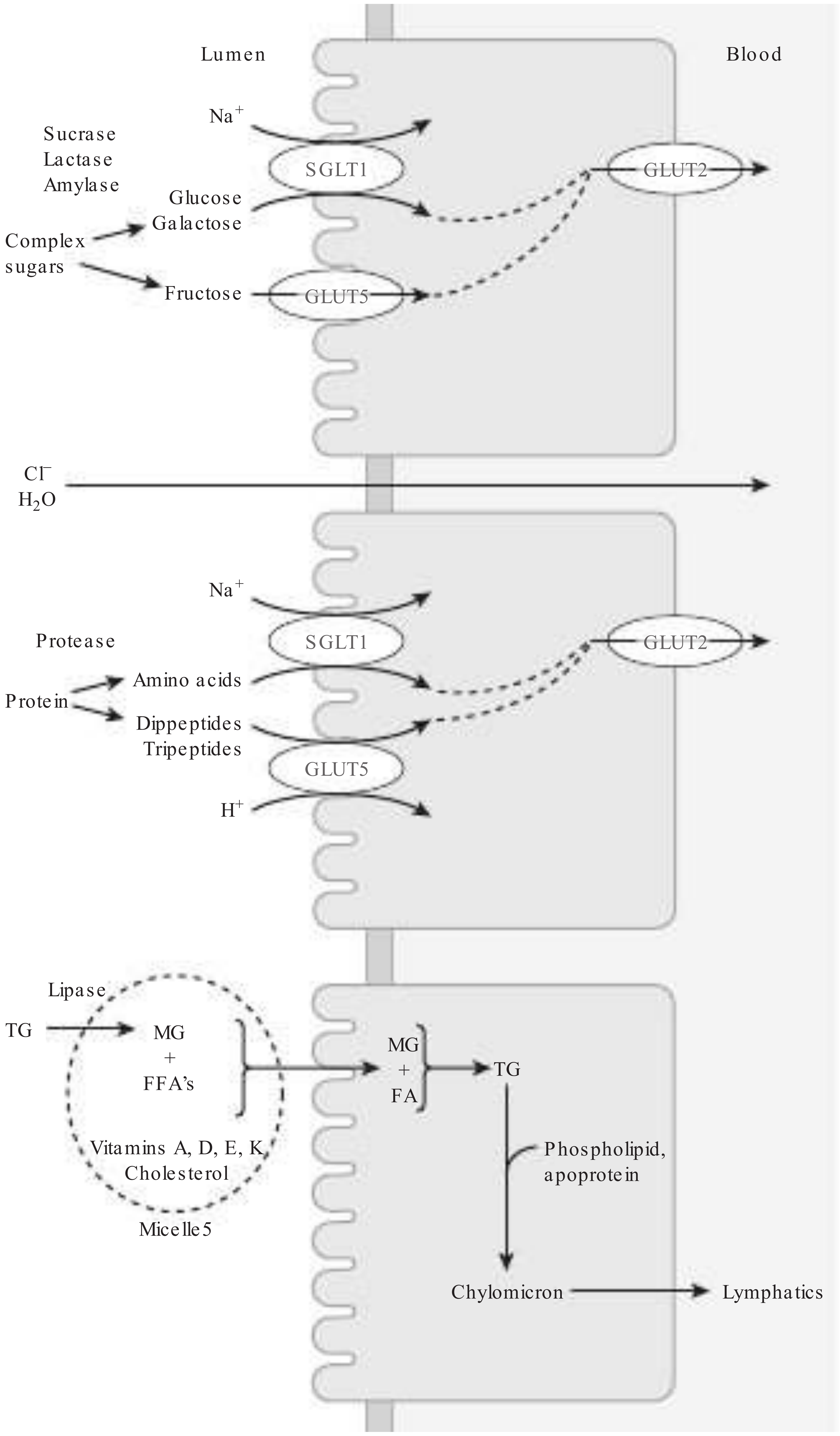


Figure 7.8. Major nutrient transport systems of the small intestine.

- **Maldigestion**: impaired digestion of nutrients within the intestinal lumen or at the brush border
- **Malabsorption**: impaired absorption of nutrients
    - **Global malabsorption:** impaired absorption of almost all nutrients due to diffuse mucosal disease or reduced surface area, for example, celiac disease
    - **Partial/isolated malabsorption:** impaired absorption of specific nutrients, for example, pernicious anemia
- Small intestinal epithelium has specialized transport processes to absorb nutrients
- Absorptive surface area is increased by intestinal villi and microvilli

CAUSAL CONDITIONS (Table 7.17)

TABLE 7.17 • Differential Dx and common Sx of chronic diarrhea

Steatorrhea/Secretory	Large Bowel	Small Bowel
Oily, foul, difficult to flush; indicates malabsorption	Small volume, bloody (if inflammatory), painful cramps, tenesmus, urgency	Large volume, watery, weight loss, malnourished

Luminal phase
• Substrate hydrolysis
  ◦ Pancreatic insufficiency
• Fat solubilization
  ◦ Liver cholestasis
	Secretory
	• Secretory villous adenoma
	• Collagenous colitis
	• Bile salt malabsorption
		Osmotic
		• Mg, phosphate, sulfate
		• Carbohydrate malabsorption

Mucosal malabsorption
• Celiac disease
• Ileal disease/resection
• Bacterial overgrowth
• Radiation enteritis
• Amyloid/connective tissue diseases
	Inflammatory
	• IBD
	  ◦ UC
	  ◦ Crohn colitis
	• Infectious
	  ◦ Pseudomembranous colitis
	  ◦ TB
	  ◦ Viral
	  ◦ Amebiasis
	• Other
	  ◦ Radiation
	  ◦ Ischemic colitis
	• Motility
	  ◦ IBS
	  ◦ Hyperthyroidism
		Secretory
		• Neuroendocrine tumors
		  ◦ Gastrinoma
		  ◦ VIPoma
		  ◦ Carcinoid
		  ◦ Mastocytosis
		• Mucosal
		  ◦ Crohn's
		  ◦ Celiac sprue
		  ◦ Whipple disease
		  ◦ Lymphoma
		Disordered motility
		  ◦ Diabetic autonomic neuropathy
		  ◦ Hyperthyroidism
		Infectious
		  ◦ Giardia
		  ◦ HIV-associated infections

IBS

Rome criteria for IBS: recurrent abdominal pain or discomfort at least 3 d/mo in the last 3 mo associated with two or more of the following:
- Improvement with defecation
- Onset associated with alteration in stool frequency
- Onset associated with alteration in stool form (appearance)

APPROACH

History

- Stool characteristics (frequency, duration, timing of onset, constituency, alleviating/aggravating)
- Presence of fecal incontinence
- Abdominal pain/fever/chills/weight loss

ASC box

Components of Fat Digestion and Absorption

- Mastication and gastric mixing
- Lingual lipase and gastric lipase
- Pancreatic lipase (with colipase)
- Pancreatic HCO_3^- secretion for optimal fat digestion
- Large intestine mainly involved in water reabsorption
- Bile acids promote formation of micelles

CLINICAL box

Extraintestinal Manifestations of IBD: “A SICK APe”

Aphthous ulcers (Crohn disease)
Sclerosing cholangitis (UC or Crohn colitis)
Iritis
Clubbing of fingers
Kidney (oxalate renal stones—Crohn disease)
Arthritis, ankylosing spondylitis
Pyoderma gangrenosum
Erythema nodosum

- Medical Hx (e.g., hyperthyroidism, diabetes mellitus, acquired immunodeficiency syndrome)
- Medications

Physical exam

- General: fluid status, signs of malnourishment
- Skin: rashes on skin, ulcers
- Cardiac: murmurs
- Abdomen: masses, ascites, organomegaly, rectal tone

Investigations

Laboratory

- CBC
- Electrolytes/creatinine
- Liver enzymes/function tests

Stool Tests

- Leukocytes (suggests inflammatory)
- Occult blood
- Stool osmotic gap ($[290 \text{ mOsm/kg} - 2(\text{Na}^+ + \text{K}^+)]$)
  - Gap < 50 = secretory
  - Gap > 100 = osmotic
- Fecal fat ($> 8\%$ excretion suggests pancreatic insufficiency.)

Secondary Testing Based on Underlying Diarrhea Type

Inflammatory

- Endoscopy (Table 7.18)
- *C. difficile* toxin

TABLE 7.18 • Endoscopic Findings of IBD

Crohn’s	UC
Transmural inflammation of small bowel, colon, or both with skip areas of normal bowel	Mucosal/submucosal inflammation of rectum spreading proximally in a continuous manner without skip areas, may have backwash ileitis

Secretory

- Stool cultures, including ova and parasites
- Endoscopy
- TSH

Fatty

- Small bowel follow-through/upper endoscopy
- CT abdomen (looking for structural cause)
- Test pancreatic sufficiency

Osmotic

- Stool pH (< 5.6) suggests carbohydrate malabsorption.
- Malabsorption: hydrogen breath test

Diagnosis

- Made through clinical assessment and result of testing based on type of diarrhea
- See Figure 7.9

Management

Initial

- Volume repletion and diet recommendations (see Acute Diarrhea—Management)
- Treat specific cause if known (e.g., immunosuppressive Rx for IBD)
- Empiric Rx is recommended when:
  - Awaiting diagnostic testing
  - Unclear Dx or
  - No specific/effective Rx available
- For unexplained steatorrhea, therapeutic trials of pancreatic enzyme replacement and conjugated bile acid supplementation
- Probiotics

CLINICAL box

Referral to a Gastroenterologist

- If diarrhea is bloody or associated with constitutional Sx (e.g., weight loss, fever)
- Etiology unknown despite extensive testing and therapeutic trials

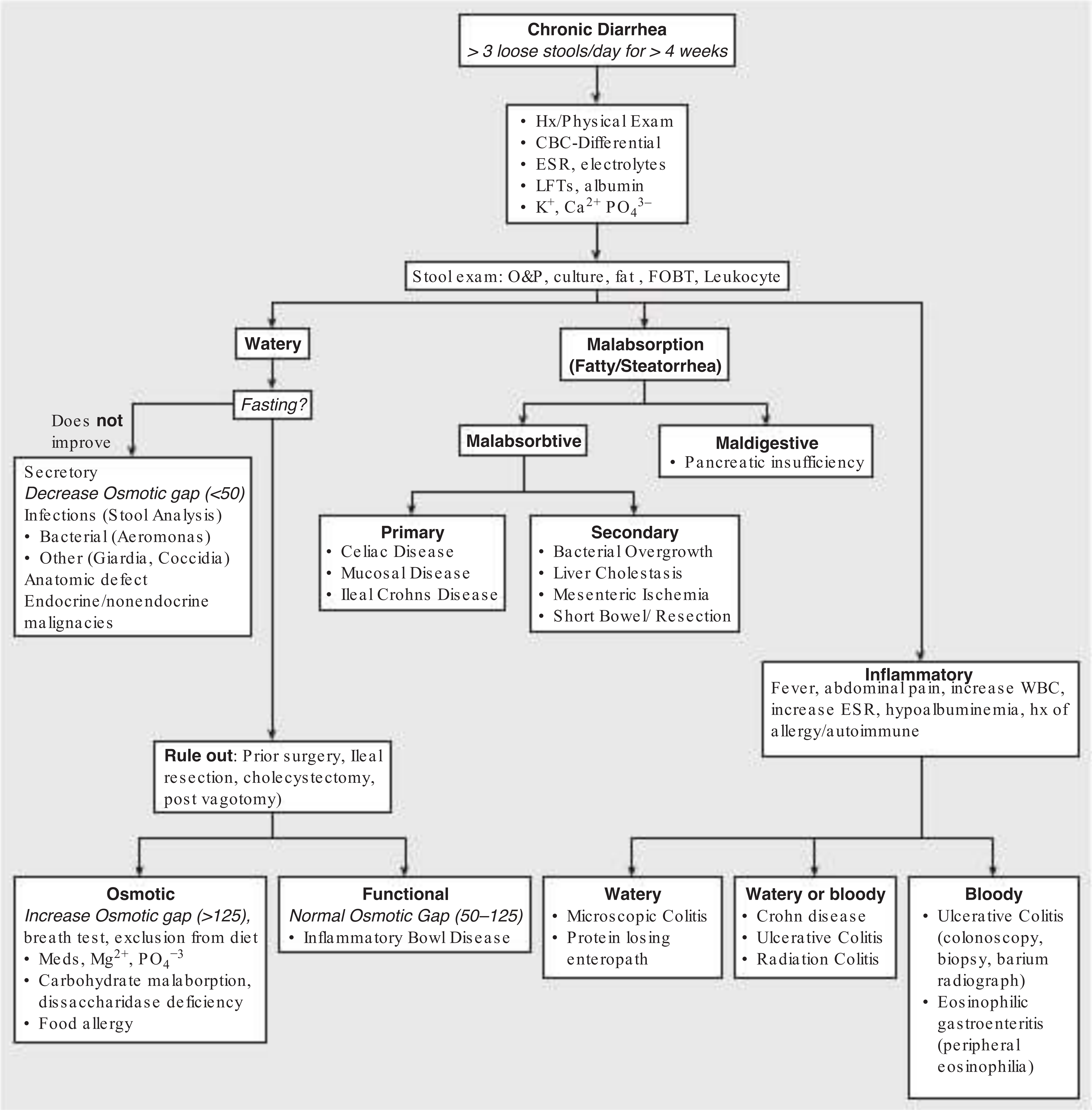

Chronic Diarrhea
> 3 loose stools/day for > 4 weeks
• Hx/Physical Exam
• CBC-Differential
• ESR, electrolytes
• LFTs, albumin
• K+, Ca2+ PO43–
Stool exam: O&P, culture, fat , FOBT, Leukocyte
Watery
Fasting?
Does not improve
Secretory
Decrease Osmotic gap (<50)
Infections (Stool Analysis)
• Bacterial (Aeromonas)
• Other (Giardia, Coccidia)
Anatomic defect
Endocrine/nonendocrine malignacies
Malabsorption (Fatty/Steatorrhea)
Malabsorbtive
Maldigestive
• Pancreatic insufficiency
Primary
• Celiac Disease
• Mucosal Disease
• Ileal Crohns Disease
Secondary
• Bacterial Overgrowth
• Liver Cholestasis
• Mesenteric Ischemia
• Short Bowel/ Resection
Inflammatory
Fever, abdominal pain, increase WBC, increase ESR, hypoalbuminemia, hx of allergy/autoimmune
Rule out: Prior surgery, Ileal resection, cholecystectomy, post vagotomy)
Osmotic
Increase Osmotic gap (>125),
breath test, exclusion from diet
• Meds, Mg2+, PO4–3
• Carbohydrate malaborption, dissaccharidase deficiency
• Food allergy
Functional
Normal Osmotic Gap (50–125)
• Inflammatory Bowl Disease
Watery
• Microscopic Colitis
• Protein losing enteropath
Watery or bloody
• Crohn disease
• Ulcerative Colitis
• Radiation Colitis
Bloody
• Ulcerative Colitis (colonoscopy, biopsy, barium radiograph)
• Eosinophilic gastroenteritis (peripheral eosinophilia)

Figure 7.9. Approach to Dx of chronic diarrhea.

ADULT CONSTIPATION

MCC OBJECTIVE

Based on Objective #16-1 (Adult Constipation) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Definition is patient- and physician-dependent and includes:

- Infrequent bowel movements (< 3 times/wk) for at least 12 wk
- Straining, hard stools, incomplete evacuation, anorectal obstruction, and/or manual maneuvers for 25% of defecations

- Patient does not meet criteria for IBS
- In patients > 80 yr, almost one-third complain of constipation

History

- Exclude low fiber and inactivity
- Stool pattern; is there diarrhea alternating with constipation?
- Obtain 2-wk bowel diary
- Drug Hx with temporal relationship
- Medications used including laxatives
- Digital manipulation required?

Alarm Features

- Hematochezia (blood/mucous)
- Weight loss > 10 lb
- Family Hx of CA/IBD
- Anemia
- Positive fecal occult blood test
- Abdominal pain

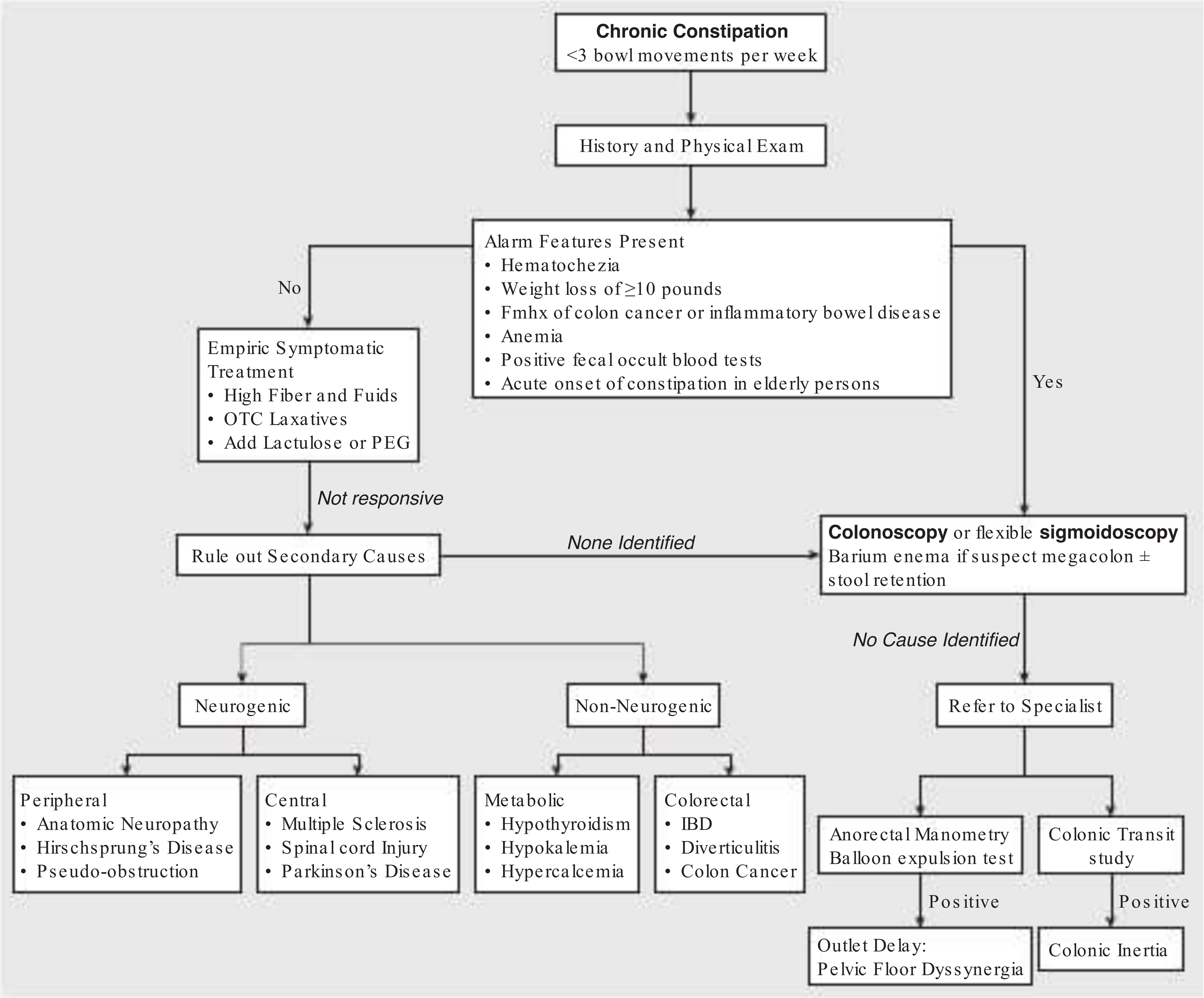


Figure 7.10. Approach to adult constipation.

(Adapted from American Gastroenterological Association. American Gastroenterological Association medical position statement on constipation. *Gastroenterology.* 2013;144(1):211–217.)

- Ribbon-like stool
- Acute onset in elderly
- Age > 50 yr (for screening)

Investigations

- See Figure 7.10.

Diagnosis

- Response to laxatives and fiber suggests functional constipation.
- Colonic transit and anorectal manometry help distinguish between slow colonic transit constipation, pelvic floor dysfunction, or combination of the two.

Management (Figure 7.10 and Table 7.19)

TABLE 7.19 • Pharmacological management of constipation

Bulking agents (goal about 25 g fiber/d)	• Psyllium • Methylcellulose • Flax seed

Laxatives	• Osmotic
	  • Lactulose
	  • Polyethylene glycol
	  • Magnesium/phosphate sulfate
	• Softener
	  • Docusate
	• Stimulation
	  • Senna
	  • Bisacodyl

Enemas	• Tap water • Mineral oil
Secretagogues	• Lubiprostone
5-HT_4 Agonist	• Prucalopride

CAUSAL CONDITIONS (Table 7.20)

TABLE 7.20 • Differential Dx of constipation

Disordered Lower Intestinal Motility	2° Constipation
Diet (↓ calorie, ↓ fiber, or ↓ fluid intake) Inactivity Drugs • Analgesics • Anticholinergics (e.g., antihistamines, antispasmodics, antidepressants, antipsychotics) • Cation-containing (e.g., iron supplements, aluminum) • Neurally active (e.g., opiates, antihypertensives) Idiopathic • 70%—IBS • 15%—pelvic floor dysfunction (dyssynergic defecation) • 10%—normal/slow colonic transit	Neurogenic—central • MS • Parkinson's • Spinal cord injury Neurogenic—peripheral • Autonomic neuropathy • Diabetes mellitus • Hirschsprung disease • Intestinal pseudo-obstruction Metabolic • Hypercalcemia • Hypokalemia • Hypothyroidism Pregnancy Obstructing lesions • Anorectal (e.g., fissures, hemorrhoids, strictures) • Colorectal (e.g., neoplasm, inflammatory disease, diverticular disease) • Bowel obstruction

FECAL/STOOL INCONTINENCE

MCC OBJECTIVE

Based on Objective #47-1 (Fecal Incontinence) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- **Definition:** continuous or recurrent uncontrolled passage of fecal material (> 10 mL) for > 1 mo
- **Minor incontinence:** inadvertent escape of flatus or partial soiling with liquid stool
- **Major incontinence:** involuntary excretion of feces
- **Prevalence:** 11% to 15% of community-dwelling adults, 40% to 50% of nursing home residents
- Affects self-confidence and may lead to social isolation

APPLIED SCIENTIFIC CONCEPTS (Figure 7.11)

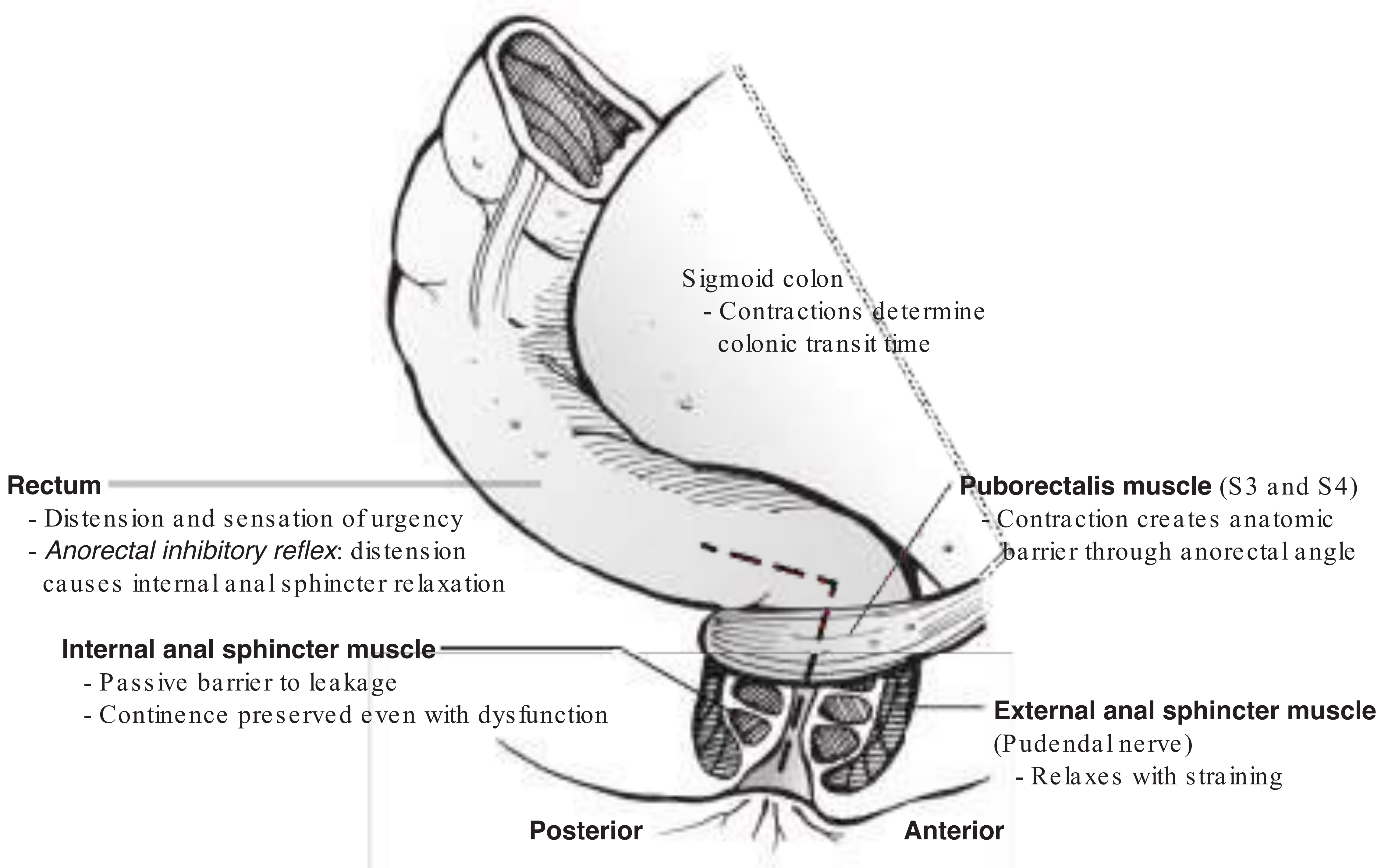

Sigmoid colon
- Contractions determine colonic transit time
Rectum
- Distension and sensation of urgency
- *Anorectal inhibitory reflex*: distension causes internal anal sphincter relaxation
Puborectalis muscle (S3 and S4)
- Contraction creates anatomic barrier through anorectal angle
Internal anal sphincter muscle
- Passive barrier to leakage
- Continence preserved even with dysfunction
External anal sphincter muscle (Pudendal nerve)
- Relaxes with straining
Posterior
Anterior

Figure 7.11. Anatomy of the distal colon, rectum, and anal canal.

CAUSAL CONDITIONS

- See Table 7.21.

APPROACH (Figure 7.12)

History

- True incontinence versus frequency/urgency (IBS/IBD)
- Onset, duration, frequency, severity, and precipitants
- Diarrhea with incontinence
- Risk factors for fecal incontinence (spinal cord injury, pelvic radiation)
  - Obstetrical Hx in women (forceps, tears)

TABLE 7.21 • Differential Dx of fecal incontinence

Pelvic Floor Intact	Pelvic Floor Affected
Neurologic • Age-related (e.g., dementia, strokes) • Neuropathy (e.g., diabetes mellitus, congenital megacolon, Hirschsprung disease) • Congenital anomalies (e.g., myelomeningocele) • MS • Tumors of CNS (brain, spinal cord, cauda equina) • Trauma to CNS **Overflow** • Fecal impaction • Rectal tumors **Diarrhea** • Infection • IBD **Drugs** • Laxatives • Muscle relaxants • Antidepressants • Caffeine **Pelvic irradiation**	**Trauma** • Pelvic fracture • Anorectal surgery (for fistulas, hemorrhoids) • Vaginal delivery **Nerve/sphincter damage** • Vaginal delivery • Descending-perineum syndrome • Rectal prolapse • Chronic straining (↓ sensitivity) **Malformation** • Congenital anorectal malformation

Physical exam

- Neurologic exam of back and lower limbs
- External perianal exam (fistula, hemorrhoids, rectal prolapse)
- Perianal sensation (anocutaneous reflex/anal wink sign)
- Digital exam (resting and squeeze tone, mass, fecal impaction)

Investigations

- Testing based on clinical presentation
- Metabolic and organic etiologies need to be excluded in patients with diarrhea and incontinence
  - Endoscopy, stool testing for infection, TSH, fasting glucose
- Anorectal manometry and anorectal ultrasound useful if question of sphincter/neurologic injury
- Defecography: major use is to evaluate suspected rectal prolapse

Management

- General lifestyle
  - Avoiding offending foods, good perianal hygiene, regularly scheduled bowel movements, decreased caffeine
- Pharmacologic
  - Loperamide, diphenoxylate (antidiarrheals)
- Biofeedback
  - Strengthening sphincter muscles
  - Improving rectal sensation
- Surgery
  - Local bulking of sphincter tone (collagen, hyaluronic acid/dextranomer)
  - Sphincter repair
  - Artificial sphincter
  - Colostomy

ASC box

Physiology of Defecation

1. Propagated colonic contraction
2. Rectal distention
3. If desire to defecate:
   1. Internal sphincter relaxation
   2. Voluntary straightening of anorectal angle (sitting), increased intra-abdominal pressure (straining), relaxation of puborectalis and external sphincter
4. Fecal expulsion

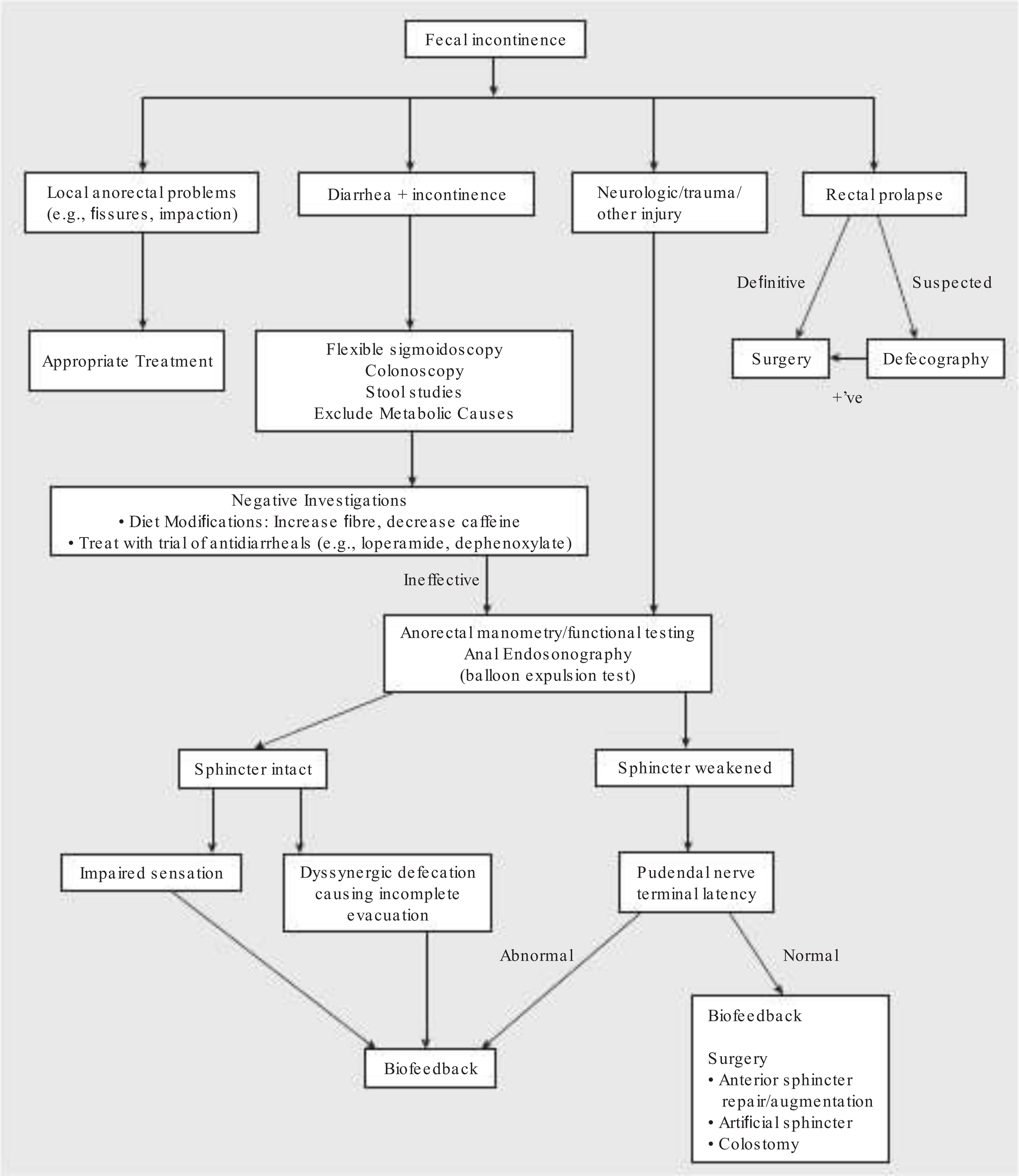


Figure 7.12. Approach to diagnosis and management of fecal incontinence.
(Adapted from Rao S. Diagnosis and management of fecal incontinence. *Am J Gastroenterol.* 2004;99:1585.)

ADULT HEPATOMEGALY

MCC OBJECTIVE

Based on Objective #2-2 (Hepatomegaly) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Hepatomegaly may be diagnosed during routine exam or after diagnostic tests.
- The liver edge may be palpable without actual hepatic enlargement; the liver span needs to be estimated.
- The etiology of hepatomegaly and disease extent are needed for prognosis.

CAUSAL CONDITIONS (Table 7.22)

TABLE 7.22 • Differential Dx of hepatomegaly

	Major Causes
Congestive	• Right heart failure • Budd-Chiari syndrome
Infiltrative	• Malignant ◦ Metastatic CA ◦ Lymphoproliferative ◦ Leukemia ◦ Polycythemia • Nonmalignant ◦ Fat (**most commonest cause**)—alcoholic and nonalcoholic ◦ Cysts ◦ Hemochromatosis ◦ Wilson disease ◦ Myeloid metaplasia ◦ Amyloid ◦ Metabolic myopathies
Proliferative	• Infectious ◦ Acute viral ◦ TB ◦ Pyogenic abscess ◦ Echinococcus • Inflammatory ◦ Alcoholic/chronic hepatitis ◦ Sarcoidosis ◦ Histiocytosis X • Neoplastic (primary hepatocellular CA) • Benign tumors ◦ Hepatic adenoma ◦ Cavernous hemangioma ◦ Focal nodular hyperplasia

APPROACH

History

- Sx of CHF—fatigue, SOB, chest pain, orthopnea, palpitations, dizziness, fainting, cough
- Abdominal pain, onset of jaundice
- Fever, malaise, weight gain/loss
- Travel Hx, occupation, infectious disease exposure
- Medical Hx: diabetes mellitus, obesity, dyslipidemia
- Family Hx of liver disease (hemochromatosis, Wilson disease)
- Meds and allergies

- Intake of EtOH, IV drug use, HIV status
- Vaccinations

Physical exam (Tables 7.23 and 7.24)

TABLE 7.23 • Physical exam for hepatomegaly

Vital Signs	
Fever, tachycardia	Hepatitis, liver abscess, sepsis
Tachypnea and/or Cheyne-Stokes respiration	Heart failure, sepsis
Hypertension	Heart failure
Weight (estimate BMI)	Fatty infiltration
Skin and Mucosa	
Cold clammy skin and cyanosis	CHF
Warm clammy skin, petechiae, rash, splinter hemorrhages	Sepsis
Jaundice	Hepatic involvement, malignancy
Spider nevi, palmar erythema	Stigmata of chronic liver disease
Dupuytren contracture	Alcoholic liver disease
Lymphadenopathy	Infection/malignancy
Cardiac/Respiratory	
Elevated JVP, gallop rhythm, S_3, peripheral edema, orthopnea, lower lobe crackles	CHF
Abdominal Exam	
Abdominal distension, positive fluid wave, shifting dullness, dull percussion	Ascites

TABLE 7.24 • Examination of the liver

Percussion	
Liver span	Distinguish between liver displacement and enlargement
Palpation	
Liver tenderness	Inflammatory processes including hepatitis, abscess or congestion from Budd-Chiari syndrome (i.e., hepatic vein thrombosis)
Pulsatile liver	Right-sided heart failure and hepatic congestion
Liver texture	Hard: suggestive of CA
	Firm: infiltrative disease
	Nodular: cirrhosis (although the liver is usually shrunken)
Auscultation	
Hepatic bruits and rubs	Hepatic neoplasia, inflammation, abscesses

Investigations

- CBC, PT, aPTT/INR
- Electrolytes, creatinine, BUN, fasting glucose
- Liver: ALT, AST, GGT, ALP, bilirubin, albumin
- Iron studies: ferritin, transferrin, TIBC
- ECG, CXR, echocardiogram (if cause is thought to be primary cardiac hepatic congestion)
- Abdominal U/S and Doppler studies of hepatic vasculature
- Abdominal CT, MRI
- Blood cultures for aerobic, anaerobic, and fungal microorganisms

Management

- Rx depends on underlying cause
- Consult gastroenterologist or hepatologist in patients with liver disease
- Consult hepatobiliary surgeon if hepatobiliary neoplasm
- Consult cardiologist in patients with CHF and place on low salt (< 2 g/d)

ABNORMAL LIVER FUNCTION TESTS

MCC OBJECTIVE

Based on Objective #52 (Abnormal Liver Function Tests) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Abnormal LFTs are commonly found on routine screening in ASx patients.
- Intensive workup is not necessary until LFTs are more than two-fold the upper limit of normal for over 6 mo.

APPLIED SCIENTIFIC CONCEPTS (Tables 7.25 and 7.26)

TABLE 7.25 • Liver enzymes and liver function tests

System Affected	Liver Test	
Hepatocyte injury	↑↑AST (also in skeletal and heart muscle) ↑↑ALT (liver specific)	↑GGT + ↑ALP (because ALP also in bone, gut, placenta)
Cholangiocyte injury	↑↑GGT + ↑↑ALP	↑Cholesterol (chronic)
Liver biosynthesis	↑INR (advanced disease)	Albumin (chronic disease)
Liver metabolic capacity	↑Bilirubin	Bile acids (not a routine LFT)

↑, increase and ↑↑, higher increase.

Strictly speaking, bilirubin, glucose, INR, and albumin are true liver function tests, but the liver enzymes ALT, AST, ALP, and GGT are often lumped into the LFT term.

TABLE 7.26 • Differentiating viral hepatitis

	Transmission	Prophylaxis Indications	Prevention	Natural Hx
Hepatitis A	Fecal-oral Parenteral (uncommon)	Vaccine: travel to developing countries, chronic liver disease, HIV+, homosexual IVIg: postexposure (if < 2 wk)	Wash hands before handling food Vaccine	Incubation: 2–4 wk Sx: ASx, GI illness, jaundice Chronic carrier: n/a Mortality: 0.1%, usually from fulminant hepatitis
Hepatitis B	Sexual Vertical Parenteral	Vaccine: health care workers, chronic liver disease, IV drug user IVIg: newborns (if mother is HBsAg^{+}), postexposure	Condoms Vaccine before travel to endemic areas (SE Asia, Africa) Public health: vaccinate all children	Incubation: weeks to 6 mo Acute Sx: fever, arthralgia, rash (maculopapular or urticaria) Chronic: usually ASx Mortality: < 1% have fulminant hepatitis, ↑HCC risk
Hepatitis C	Parenteral Intranasal cocaine Sexual (uncommon) Prevalence: 1%	Vaccine: n/a IVIg: n/a	Abstinence from IV drugs, cocaine, dirty tattoo needles	Incubation: 5–10 wk Sx: few, 80% become chronic Chronic: slowly progressive Morbidity: cirrhosis

IVIg, intravenous immunoglobulin.

CLINICAL box

Hepatomegaly Associated with Splenomegaly

- Hematologic and myeloproliferative disorders
- Lymphoma
- Leukemia

!

Liver biopsy—consider consultation with gastroenterologist/hepatologist or hepatobiliary surgeon—risk of bleeding, seeding of malignancy along needle track, etc.

CLINICAL box

Abbreviations for LFTs

ALT = Alanine aminotransferase
AST = Aspartate aminotransferase
ALP = Alkaline phosphatase
GGT = d-glutamyl transpeptidase
INR = International normalized ratio
LFT = Liver function test

HCV: Informing Contacts

Risk of transmission of HCV infection between monogamous stable sexual partners is low (< 1% annually). The decision to inform contacts regarding this potential for infection rests with the physician and patient.

Can MED

APPROACH

History

- Symptoms
  - Jaundice, pruritus, rash
  - Arthralgias, myalgias
  - Fever, weight loss, abdominal pain, chills
  - Changes in bowel/urinary patterns (acholic stool, dark urine)
- Medical Hx: diabetes, hypertension, high lipids
- Family Hx: Wilson disease, hemochromatosis
- Social Hx: EtOH, illicit drug use (cocaine)
- Parenteral exposures: transfusion, IV drug use, tattoos, sexual activity
- Other exposures: recent travel Hx, sick contacts, food, toxins

Physical exam (Table 7.27)

Table 7.27 • Physical findings with abnormal liver tests

System	Finding	Comments
Neurologic	Encephalopathy	Advanced liver disease
Head and neck	Jaundice (scleral icterus) Fetor hepaticus Left supraclavicular (Virchow's) node	Advanced liver disease May suggest GI malignancy
Cardiovascular	JVD	Hepatic congestion
Respiratory/chest	Pleural effusion Gynecomastia[a]	Hepatic congestion, advanced liver disease Advanced liver disease
Abdominal	Ascites Splenomegaly Hepatomegaly Prominent abdominal collaterals (caput medusa)[a] Periumbilical (Sister Mary Joseph's) node	Advanced liver disease May suggest GI malignancy
Skin and Extremities	Peripheral edema[a] Palmar erythema[a] Telangiectasia/spider nevi[a] Clubbing Dupuytren contractures	Advanced liver disease
GU	Testicular atrophy[a]	Advanced liver disease

[a] Stigmata of chronic liver disease.

Investigations (Table 7.28)

Table 7.28 • Abnormal lab investigations

Liver Test	Found in
AST	Liver, heart, skeletal muscle, kidney, and brain
ALT	Liver (predominantly)
ALP	Hepatic canalicular membrane, bone, intestines, kidney, and placenta
GGT	Hepatocytes, biliary epithelial cells
Other Tests	
Albumin	↓ In chronic liver failure
PT	↑ If ↓ production of coagulation factors
Bilirubin	Both conjugated and unconjugated forms

Indications for Abdominal Ultrasound
- Abdominal, flank, or back pain (with clinical indications)
- Palpable abnormalities
- Abnormal lab values suggesting abdominal pathology
- Detect ascites in abdominally obese
- Locate appropriate site for paracentesis
- Detect hepatic malignancy (primary or metastatic)

Indications for Ascitic Fluid Tap (Both Diagnostic and Therapeutic)
- New-onset ascites (inpatient or outpatient)
- Worsening ascites
- Anyone with ascites showing signs/Sx of infection (fever, hypotension, peripheral leukocytosis, encephalopathy, acidosis)

Indications for Liver Biopsy
- Unexplained abnormal liver enzymes
- Unexplained hepatosplenomegaly
- Unexplained intrahepatic cholestasis
- Suspected malignancy
- Dx and/or staging alcoholic liver disease, NASH, or chronic hepatitis

CAUSAL CONDITIONS

The pattern of liver enzyme abnormality helps in diagnosis (Tables 7.29–7.32).

TABLE 7.29 • Hepatocellular (predominantly ä AST, ALT)

Drugs and toxins	• EtOH, acetaminophen, NSAIDs, antibiotics, statins, antiepileptics • Suspect EtOH if AST:ALT is > 2:1
Nonalcoholic steatohepatitis	• Suspect if obese, diabetic, and has hyperlipidemia
Viral (hepatitis A, B, and C)	• Rare: hepatitis D and E, CMV, EBV, HSV, VZV
Less common	• Muscle disorders (polymyositis, seizures, strenuous exercise) • Measure creatine kinase, lactate dehydrogenase • Hyperthyroidism • Celiac disease • Adrenal insufficiency • Genetic conditions (hemochromatosis, Wilson disease, a_1-antitrypsin deficiency) • Autoimmune hepatitis

TABLE 7.30 • Cholestatic (predominantly ä ALP, GGT)

Biliary dilatation (extrahepatic cholestasis)	• May require other imaging (ERCP, MRI, or CT scanning) to identify site of obstruction • Choledocholithiasis (most common cause) • PSC • Malignancy (pancreatic, gallbladder, cholangiocarcinoma)
No biliary dilatation (intrahepatic cholestasis)	• Drug-induced cholestasis (steroids, chlorpromazine, imipramine, antibiotics) • PBC • PSC • Hepatitis • Others: TPN, nonhepatobiliary sepsis, postoperative, paraneoplastic syndrome

CLINICAL box

Contraindications for Ascitic Fluid Tap

Absolute: clinically evident fibrinolysis or DIC

Relative: coagulopathy, uncooperative patient, skin infection

Genetic Testing: Hereditary Hemochromatosis

- Med condition is preventable by phlebotomy if identified early enough (age 20–30 yr).
- Screening test (iron saturation > 45%) is confirmed with genetic testing (HFE gene for homozygosity in C282Y mutation).
- Positive test for HFE could preclude patients from obtaining life/med insurance.
- Ensure patients have all relevant information for appropriate decision making for each individual patient

Can MED

TAble 7.31 • Isolated hyperbilirubinemia (ä bilirubin; other liver tests relatively normal)

↑ Unconjugated bilirubin	Overproduction	Hemolysis, ineffective erythropoiesis, hematoma resorption, pulmonary embolism
	Problems with conjugation	• ↓ Bilirubin UDP-GT activity • Gilbert syndrome, Crigler-Nijjar syndrome, drug induced
↑ Conjugated bilirubin (problems with excretion)—Dubin-Johnson syndrome, Rotor syndrome		

TAble 7.32 • Infiltrative (ä ALP; other liver tests relatively normal)

Granulomatous disease	Tuberculosis, histoplasmosis, sarcoidosis
Malignancy	HCC, lymphoma, metastatic
Others	Abscess formation, meds, idiopathic

Management

- Treatment is dependent on the underlying diagnosis
- Need urgent medical attention
  - ALT/AST > 1,000
  - Suspected Tylenol overdose
  - Decreased level of consciousness
  - Elevated cholestatic enzymes with fever/right upper quadrant pain may be cholangitis
- If there is evidence of biliary obstruction on ultrasound, the patient should be referred to a gastroenterologist or surgeon
- **Malignancy:** refer to hepatobiliary surgeon
- If testing is positive for chronic liver disease (HBV, HCV, PBC, PSC, autoimmune hepatitis) or there is evidence of advanced liver disease (cirrhosis), they should be referred to a gastroenterologist or hepatologist
- Complications of liver disease (Table 7.33)

TAble 7.33 • Complications of liver disease

Sequelae	Pathophysiology
Jaundice and pruritus	Deposition of bilirubin
Peripheral edema and ascites	↓ Oncotic pressure from ↓ albumin
Coagulopathy	↓ Coagulation factors
Hepatic encephalopathy	↓ Liver detoxification → accumulation of toxins in blood and brain
Sensitivity to meds	↓ Clearance
Varices	Portal HTN
Insulin resistance and diabetes mellitus	Loss of liver function in glucose deregulation by multiple pathways
HCC	End-stage neoplasia by multiple pathways
Others	↓ Immune system, impotence, kidney dysfunction, osteoporosis

> !
>
> Jaundice can represent a medical emergency: massive hemolysis, ascending cholangitis, acute hepatic failure.

ADULT JAUNDICE

MCC OBJECTIVE

Based on Objective #49 (Jaundice) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Jaundice (or icterus) is the yellowish appearance in the skin, sclera, and mucous membrane that results from bile pigment deposition.
- Underlying cause varies from hemolysis to hepatobiliary disease.

Doctor–Patient Relationship

Maintain a nonjudgmental attitude toward all patients and care for their med conditions, even if such conditions are considered self-inflicted or the result of lifestyle (i.e., EtOH or drugs in cirrhosis).

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APPLIED SCIENTIFIC CONCEPT (Figure 7.13)

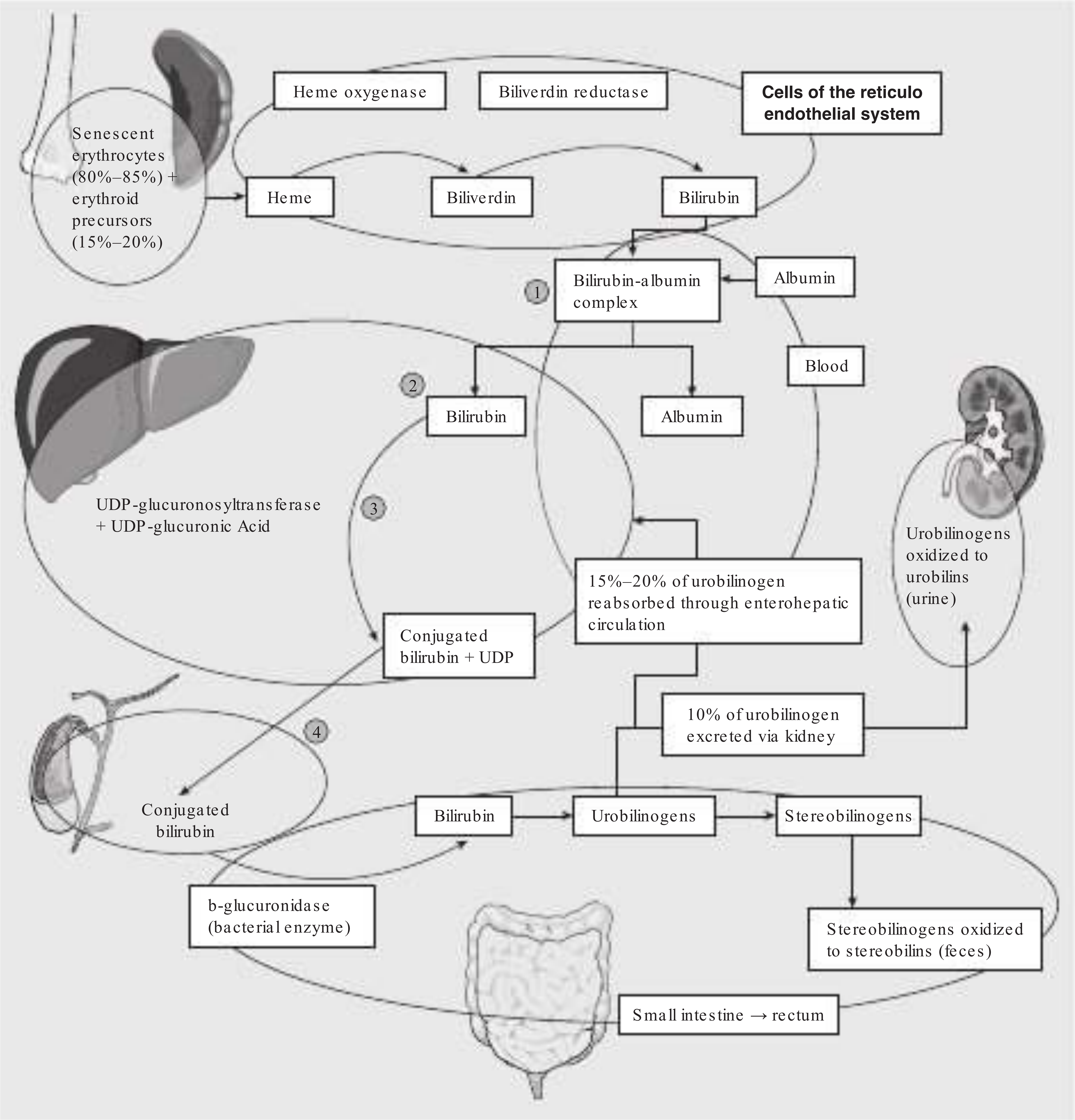
Heme oxygenase
Biliverdin reductase
Cells of the reticulo endothelial system
Senescent erythrocytes (80%–85%) + erythroid precursors (15%–20%)
Heme
Biliverdin
Bilirubin
1
Bilirubin-albumin complex
Albumin
Blood
2
Bilirubin
Albumin
UDP-glucuronosyltransferase + UDP-glucuronic Acid
3
15%–20% of urobilinogen reabsorbed through enterohepatic circulation
Urobilinogens oxidized to urobilins (urine)
Conjugated bilirubin + UDP
10% of urobilinogen excreted via kidney
4
Conjugated bilirubin
Bilirubin
Urobilinogens
Stereobilinogens
b-glucuronidase (bacterial enzyme)
Stereobilinogens oxidized to stereobilins (feces)
Small intestine → rectum

Figure 7.13. The production, metabolism, and excretion of bilirubin. There are four stages of bilirubin metabolism by the liver: (1) Uptake from the circulation, (2) intracellular storage, (3) conjugation with glucuronic acid, and (4) biliary excretion.

CAUSAL CONDITIONS (Table 7.34)

TABLE 7.34 • Differential Dx of Jaundice

	Major Causes
Prehepatic (unconjugated bilirubinemia)	• ↑ Production ◦ Hemolysis ◦ Ineffective erythropoiesis • ↓ Hepatic uptake ◦ CHF ◦ Drugs ◦ Sepsis • ↓ Bilirubin conjugation ◦ Hereditary glucuronosyltransferase deficiency ▪ Gilbert syndrome • Acquired glucuronosyltransferase deficiency ◦ Breast milk ◦ Hepatocellular disease • Neonatal jaundice (see Neonatal Jaundice)
Intrahepatic (conjugated bilirubinemia)	• Intrahepatic cholestasis ◦ End-stage cirrhosis (any etiology) ◦ Alcohol ◦ Nonalcoholic fatty liver disease ◦ HBV (**most common cause in the world**) ◦ HCV (**most common cause in North America**) • Alcoholic hepatitis (reversible or fatal) • Viral hepatitis ◦ HAV (acute cause) ◦ Chronic HBV, HCV ◦ Non-A, non-B, non-C viral hepatitis • Autoimmune ◦ PBC ◦ PSC ◦ Autoimmune hepatitis • Hereditary ◦ α_1-Antitrypsin deficiency ◦ Hemochromatosis ◦ Wilson disease • Drugs ◦ Erythromycin ◦ OCPs • Hepatocellular injury ◦ Sepsis ◦ Hypoperfusion • Miscellaneous ◦ Infiltrative states ◦ Fatty liver ◦ Sepsis

TABLE 7.34 • Continued

Posthepatic (extrahepatic cholestasis)	• Intraductal obstruction • Gallstones • Sclerosing cholangitis • Pancreatitis • Biliary malformation • Stricture • Malignancy • Cholangiocarcinoma • Bile duct compression • Malignancy

APPROACH

History

- See Table 7.34

Physical exam (Table 7.35)

TABLE 7.35 • Focused liver Hx and characteristic findings on physical exam

Hx	Findings on Physical Exam (Complications of Liver Disease)
• Onset of jaundice	• Abdominal distension (ascites)
• Meds	• Asterixis ("liver flap")
• IV drugs	• Bruising
• EtOH	• Fever
• Blood transfusions	• Gynecomastia
• Sexual activity	• Hepatomegaly vs. small liver
• Immunization status	• Jaundice
• HIV status	• JVD
• Past med Hx	• Kayser-Fleischer rings
• Family Hx	• Lymphadenopathy
• Travel	• Orthostasis
• Toxic exposure	• Palmar erythema
• Associated Sx	• Peripheral edema
• Abdominal pain	• Skin rashes, spider nevi, caput medusae
• Anorexia	• Splenomegaly
• Weight loss	• Testicular atrophy
• Fevers/chills	• Charcot triad for choledolithiasis (RUQ pain, fever, jaundice)
• Change in urine	
• Change in stool	
• Dyspepsia	
• Pruritus	

Competency and Capacity to Give Consent

Patients with liver disease may lack the capacity to give consent, and the physician should be able to conduct an assessment of the patient's competency and capacity to give consent:

- Conscious
- Cognitive ability
- Psychiatric condition
- Emotional status/maturity
- Patient subject to coercion or threat

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CLINICAL box

Liver Enzymes and Liver Function Tests

1. Direct (measured) = conjugated bilirubin (normal values 0–4 mmol/L)
2. Total (measured) = conjugated + unconjugated bilirubin (normal values 2–14 mmol/L)
3. Indirect (calculated) = unconjugated bilirubin = total − conjugated bilirubin
4. ALT is more Liver specific than AST.
5. AST:ALT ratio > 2:1 in alcohol-related liver disease, enzymes (AST, ALT) < 500 if due to alcohol alone

Management (Table 7.36)

TABLE 7.36 • Rx of common hepatobiliary conditions

Etiology	Rx
Biliary obstruction	• **ERCP** + therapeutic intervention: biliary stone removal, sphincterotomy, biliary stent placement; risk of pancreatitis or perforation • **Surgical Tx**: resection of obstructing tumor such as CA at head of pancreas, ampullary tumor, cholangiocarcinoma if respectable; cholecystectomy after ERCP
Chronic cholestatic liver disease	• PBC: ursodeoxycholic acid
End-stage liver disease	• Autoimmune hepatitis: corticosteroids • Chronic HBV: antiviral Rx (Tenofovir, Entecavir) • Chronic HCV: antiviral Rx (pegylated interferon-a with ribavirin historically; new oral agents emerging) (Ledipasvir, Sofosbubir, etc.), HCV infection subtype determines which antiviral agent is prescribed for treatment. • Alcoholic hepatitis: prednisone or pentoxifylline • All: transplant assessment; Rx of end-stage cirrhosis manifestations (lactulose for encephalopathy, diuretics for ascites, etc.); acute viral hepatitis may be observed (but not treated)
Acute hepatic failure	• Investigation of underlying causes (i.e., viral hepatitis [No Rx for acute HAV], drug hepatotoxicity [N-acetyl cysteine for acetaminophen OD], acute autoimmune disease, acute Wilson disease) • Observation for decompensation • If decompensation occurs, then transplant assessment; critical care referral if in coma

Diagnosis

- See Figure 7.14

ALLERGIC REACTIONS / FOOD ALLERGIES, INTOLERANCE, ATOPY

MCC OBJECTIVE

Based on Objective #4 (Allergic Reactions and Atopy) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW (Table 7.37)

- **Food allergy:** immune-mediated hypersensitivity to food components
- **Food intolerance:** non-immune-mediated adverse food reaction
- **Atopy:** genetic predisposition to an IgE-mediated reaction
- Patients with a single allergic reaction often present with other atopic conditions (e.g., asthma, allergic rhinitis)

CLINICAL box

Conditions Mistaken for Food Hypersensitivity

- Gastrointestinal infections
- Post-infectious malabsorption
- Carbohydrate malabsorption (e.g., lactase deficiency)
- IBD
- Anatomic abnormalities (e.g., short bowel syndrome)

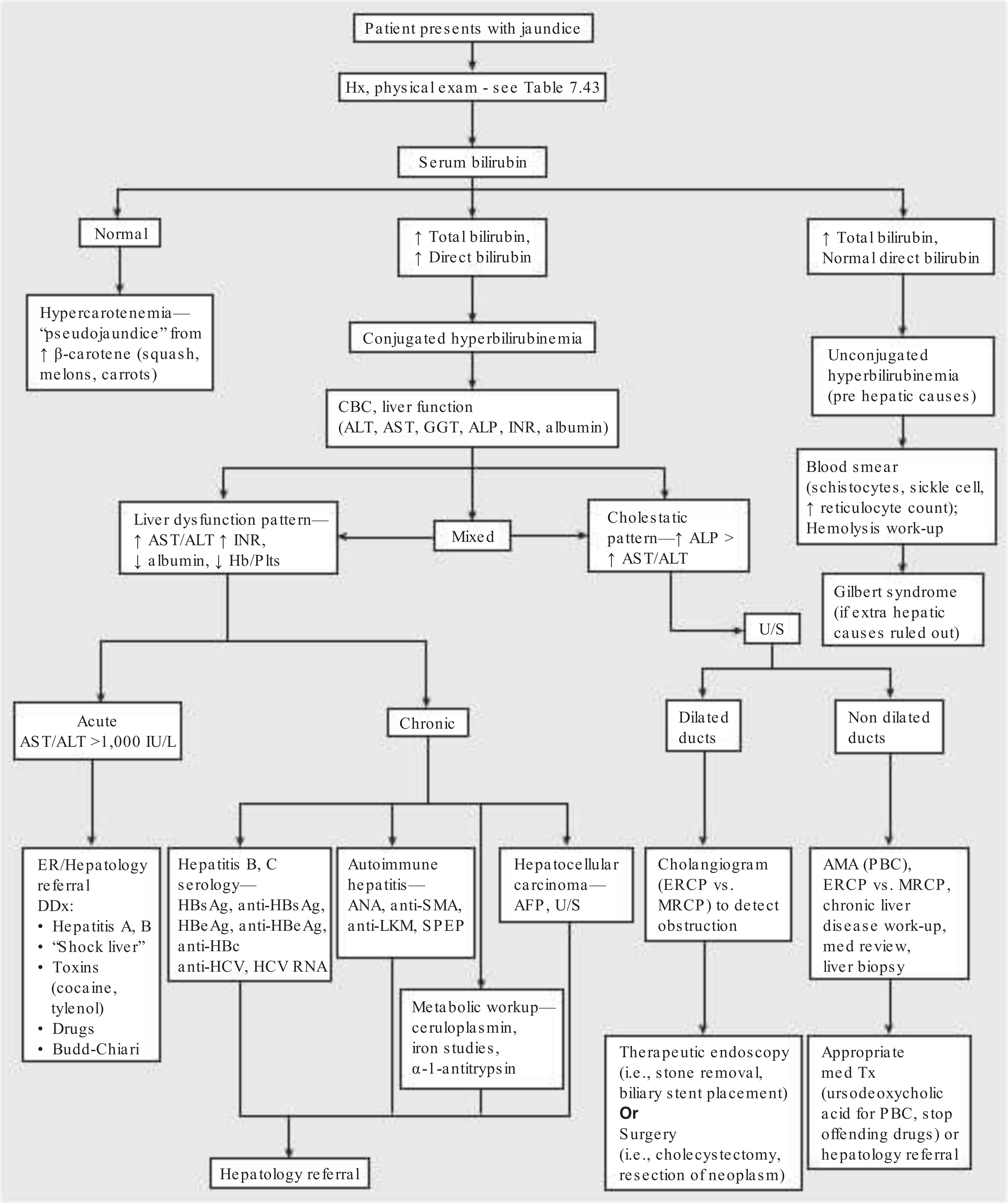

Patient presents with jaundice
Hx, physical exam - see Table 7.43
Serum bilirubin
Normal
↑ Total bilirubin, ↑ Direct bilirubin
↑ Total bilirubin, Normal direct bilirubin
Hypercarotenemia—"pseudojaundice" from ↑ β-carotene (squash, melons, carrots)
Conjugated hyperbilirubinemia
Unconjugated hyperbilirubinemia (pre hepatic causes)
CBC, liver function (ALT, AST, GGT, ALP, INR, albumin)
Blood smear (schistocytes, sickle cell, ↑ reticulocyte count); Hemolysis work-up
Liver dysfunction pattern—↑ AST/ALT ↑ INR, ↓ albumin, ↓ Hb/Plts
Mixed
Cholestatic pattern—↑ ALP > ↑ AST/ALT
Gilbert syndrome (if extra hepatic causes ruled out)
U/S
Acute AST/ALT >1,000 IU/L
Chronic
Dilated ducts
Non dilated ducts
ER/Hepatology referral
DDx:
• Hepatitis A, B
• "Shock liver"
• Toxins (cocaine, tylenol)
• Drugs
• Budd-Chiari
Hepatitis B, C serology—HBsAg, anti-HBsAg, HBeAg, anti-HBeAg, anti-HBc anti-HCV, HCV RNA
Autoimmune hepatitis—ANA, anti-SMA, anti-LKM, SPEP
Hepatocellular carcinoma—AFP, U/S
Cholangiogram (ERCP vs. MRCP) to detect obstruction
AMA (PBC), ERCP vs. MRCP, chronic liver disease work-up, med review, liver biopsy
Metabolic workup—ceruloplasmin, iron studies, α-1-antitrypsin
Therapeutic endoscopy (i.e., stone removal, biliary stent placement) Or Surgery (i.e., cholecystectomy, resection of neoplasm)
Appropriate med Tx (ursodeoxycholic acid for PBC, stop offending drugs) or hepatology referral
Hepatology referral

Figure 7.14. Diagnostic workup of a patient presenting with jaundice.

TAbl e 7.37 • Allergy versus intolerance

	Allergy	Intolerance
Immune-mediated?	Yes	No
Sx	Skin, GI, respiratory	Mainly GI
Reaction to small amount of food?	Yes	No
Example	Peanut allergy	Lactose intolerance

APPLIED SCIENTIFIC CONCEPTS (Figure 7.15)

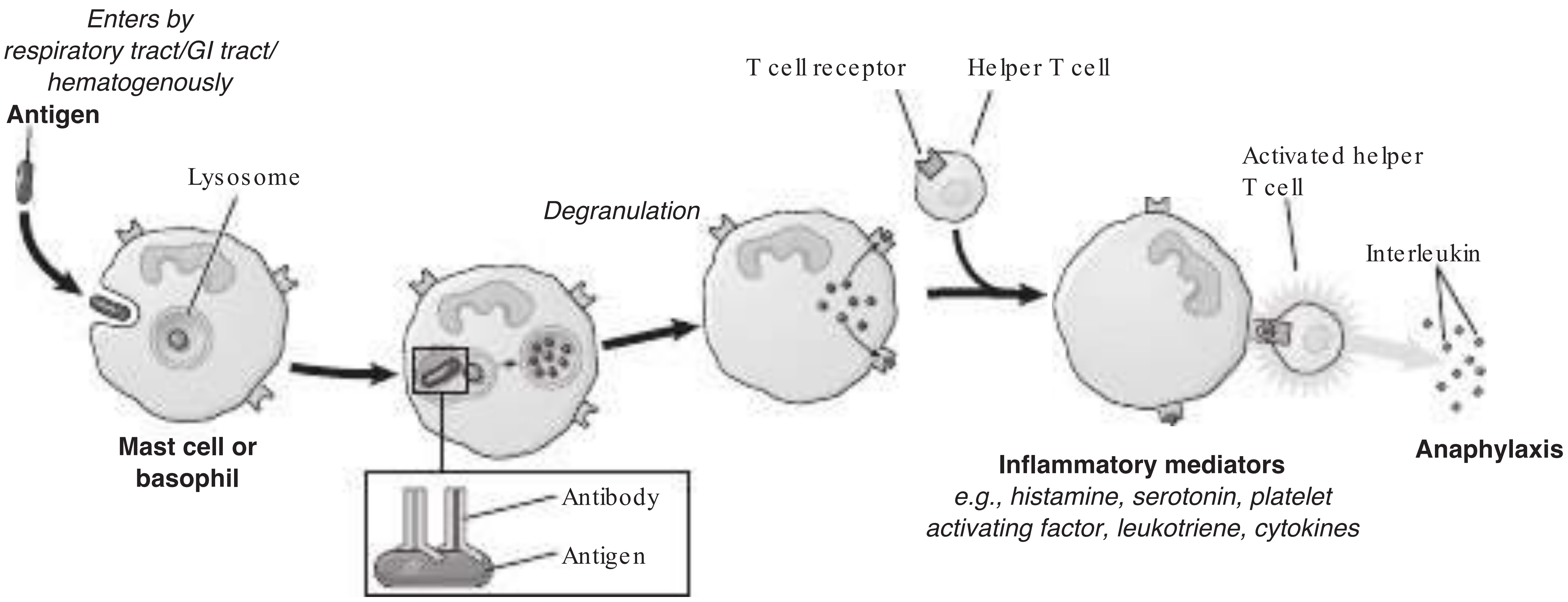


Figure 7.15. Physiologic mechanism and effects of mast cells.

CAUSAL CONDITIONS (Table 7.38)

CLINICAL box

Gastrointestinal Food Hypersensitivities

- Gastrointestinal allergy
- Eosinophilic esophagitis/gastritis/enteritis/colitis
- Celiac disease (dermatitis herpetiformis)

Table 7.38 • Common allergens: their possible effects on susceptible individuals

Common Allergen	Specific Reaction	Long-Term Tx
Food	GI (vomiting, diarrhea), skin (rashes), and airways	Avoidance
Environment	Rhinorrhea, bronchoconstriction	Avoidance, oral antihistamine, b-adrenergic agonist, anticholinergic
Insect sting	Localized pain and swelling, angioedema	Ice, oral antihistamine, antivenom Rx
Drugs (e.g., penicillin)	Varies depending on drug, e.g., malaise, fever, skin eruption, Stevens-Johnson syndrome	Avoidance
Latex	Skin eruption	Avoid latex and cross-reacting foods (banana, kiwi, avocado, chestnut)

APPROACH

History

Ask about recently ingested foods, new drugs, environmental exposures (pollen, dust mites), insect stings, family Hx of atopic conditions

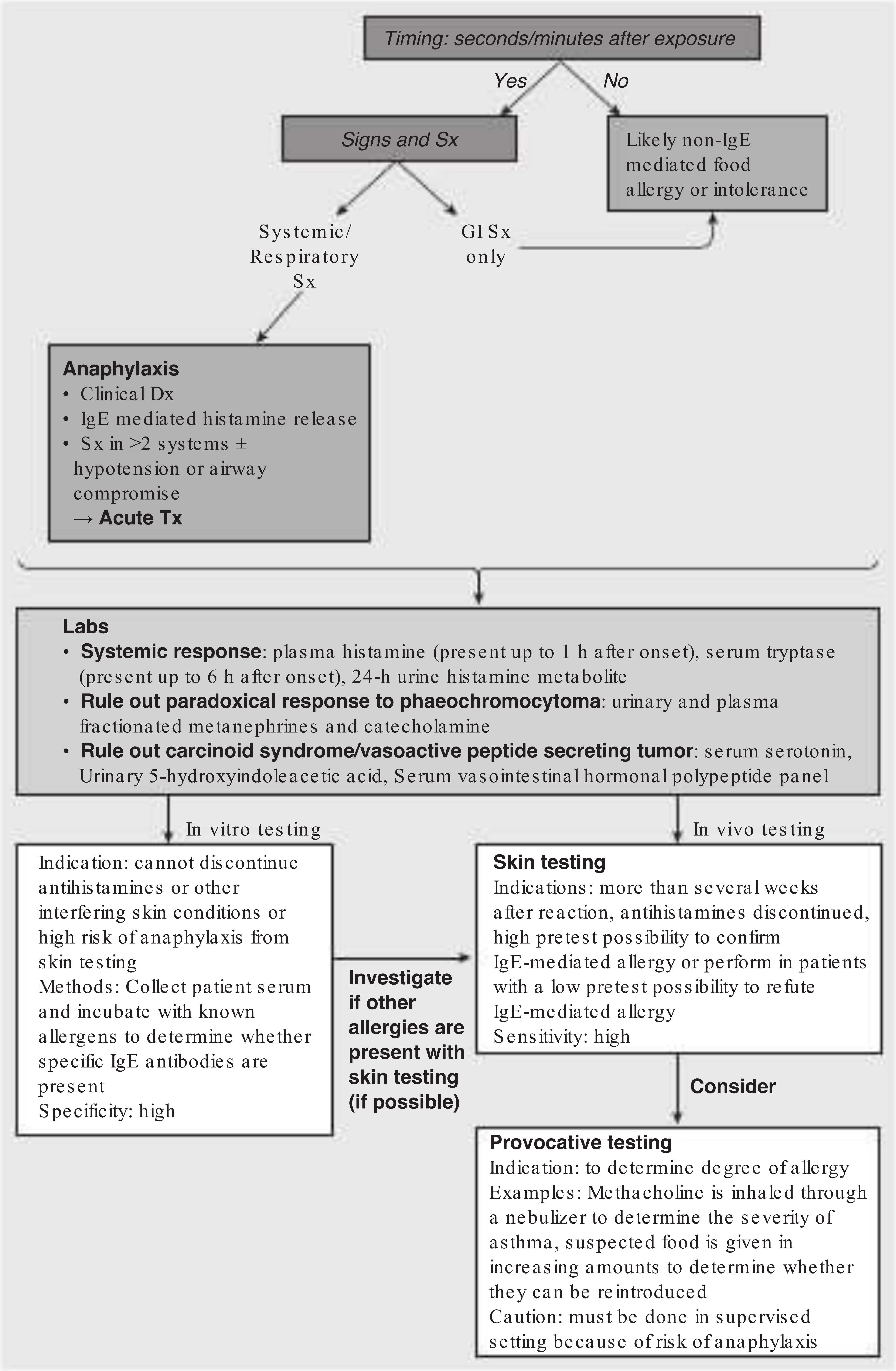
Physical exam (Table 7.39)

Table 7.39 • Physiologic Sx of anaphylaxis

Psychologic	Anxiety, sense of impending doom, irritable
Respiratory	Fullness in throat, hoarse voice, respiratory distress, stridor
Vascular	Circulatory arrest, hypotension, syncope, tachycardia
Skin	Pruritus, cutaneous flushing, urticaria, angioedema
GI	Nausea, vomiting, diarrhea, abdominal pain

Investigations

Performed predominantly to look for mimics of allergy/anaphylaxis and potential triggers (Figure 7.16)



Anaphylaxis
- Clinical Dx
- IgE mediated histamine release
- Sx in ≥2 systems ± hypotension or airway compromise

→ **Acute Tx**

Labs
- **Systemic response**: plasma histamine (present up to 1 h after onset), serum tryptase (present up to 6 h after onset), 24-h urine histamine metabolite
- **Rule out paradoxical response to phaeochromocytoma**: urinary and plasma fractionated metanephrines and catecholamine
- **Rule out carcinoid syndrome/vasoactive peptide secreting tumor**: serum serotonin, Urinary 5-hydroxyindoleacetic acid, Serum vasointestinal hormonal polypeptide panel

Indication: cannot discontinue antihistamines or other interfering skin conditions or high risk of anaphylaxis from skin testing
Methods: Collect patient serum and incubate with known allergens to determine whether specific IgE antibodies are present
Specificity: high

Investigate if other allergies are present with skin testing (if possible)

Skin testing
Indications: more than several weeks after reaction, antihistamines discontinued, high pretest possibility to confirm IgE-mediated allergy or perform in patients with a low pretest possibility to refute IgE-mediated allergy
Sensitivity: high

Provocative testing
Indication: to determine degree of allergy
Examples: Methacholine is inhaled through a nebulizer to determine the severity of asthma, suspected food is given in increasing amounts to determine whether they can be reintroduced
Caution: must be done in supervised setting because of risk of anaphylaxis

Figure 7.16. Approach to anaphylaxis.

Diagnosis

Diagnosis is based on clinical assessment.

Management

- Patients with Hx of anaphylaxis should be referred to an allergist
- Education
  - Counsel the patient, parents, and school about allergy recognition and acute treatment

  - Suggest risk reduction strategies (e.g., how to read food ingredient labels, inform of drug classes at risk for cross-reaction allergies, decrease exposure to trigger)
- Epinephrine: provide an annual prescription for epinephrine, to be carried at all times
- Medications
  - Sx-based long-term options, for example, adrenergic agonist, anticholinergic, antihistamine, glucocorticoid, cromolyn glycate, leukotriene receptor modifiers, theophylline
- Allergen immunotherapy
  - Consider allergen extracts
  - Indications: environmental allergies, allergen-induced asthma, insect venom sensitivity
  - Contraindications: simultaneous b-blocker use, initiation during pregnancy, unstable asthma
- Social/psychologic:
  - Severe allergy may impact quality of life by limiting diet, exercise, and school.
  - Immunotherapy is costly and requires time commitment, causing the caregiver stress

CLINICAL box

Acute Tx of Anaphylaxis: AEIOUS

- Antihistamine-H_1 blocker:
  - Diphenhydramine 25 to 50 mg IV
  - H_2 blocker (ranitidine 50 mg IV)
- Albuterol—2.5 to 5 mg in saline nebulizer
- Epinephrine (1:1,000 solution)—0.3 to 0.5 mg IM thigh
- Intubate—if airway involved or swelling
- Oxygen—100%
- Upright (if severe bronchospasm) or recumbent position
- Saline—normal saline, 1 to 2 L rapid bolus
- Steroid—consider methylprednisolone 125 mg IV

Listed treatment doses are for adults; use weight-based dosing for pediatric population

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CHAPTER

8

General Surgery

Ahmed Kayssi • Najma A. Ahmed • Ralph George • Gary Gamme

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Abdominal Distension
Abdominal Mass
Abdominal and Groin Hernias
Acute Abdominal Pain
Anorectal Pain
Breast Lump / Screening
Chest Injuries
Abdominal Injuries
Vascular Injuries
Preoperative Medical Evaluation

ABDOMINAL DISTENSION

MCC OBJECTIVE

Based on Objective #1 (Abdominal Distension) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Abdo distension presents in many disease processes such as ascites, ileus, bowel obstruction, organomegaly, and abdominopelvic tumors. It is important to identify and appropriately manage life-threatening emergencies such as high-grade mechanical bowel obstruction that present with abdo distension.

APPLIED SCIENTIFIC CONCEPT

Paracentesis is useful to determine the etiology of ascites. A serum to fluid albumin ratio greater than 11 g/l (mmol/L) suggests a **transudative** etiology, such as portal hypertension. Conversely, a ratio less than 11 g/L (mmol/L) suggests an **exudative** etiology, such as peritoneal carcinomatosis (Figure 8.1).

CAUSAL CONDITIONS

Ascites

- In an average-sized adult patient, ascites must be > 1.5 L for clinical diagnosis.

Bowel Dilatation

- Mechanical obstruction
  - Adhesion
  - Volvulus
  - Malignancy (intraluminal or extraluminal mass)
  - Intussusception
  - Constipation
  - Incarcerated/strangulated hernia
  - Bowel stricture (i.e., Crohn or recurrent diverticulitis)
- Pseudo-obstruction
  - Acute (such as Ogilvie's, an acute pseudo-obstruction of the colon. May occur in postoperative patients)
  - Myopathic (scleroderma, familial)
  - Enteric neuropathic (diabetes, amyloid, paraneoplastic, narcotics)
  - Extrinsic neuropathic (multiple sclerosis, spinal injury, stroke)
- Paralytic ileus
  - *C. difficile* (do not miss Dx of toxic megacolon or necrotizing enterocolitis in infants)

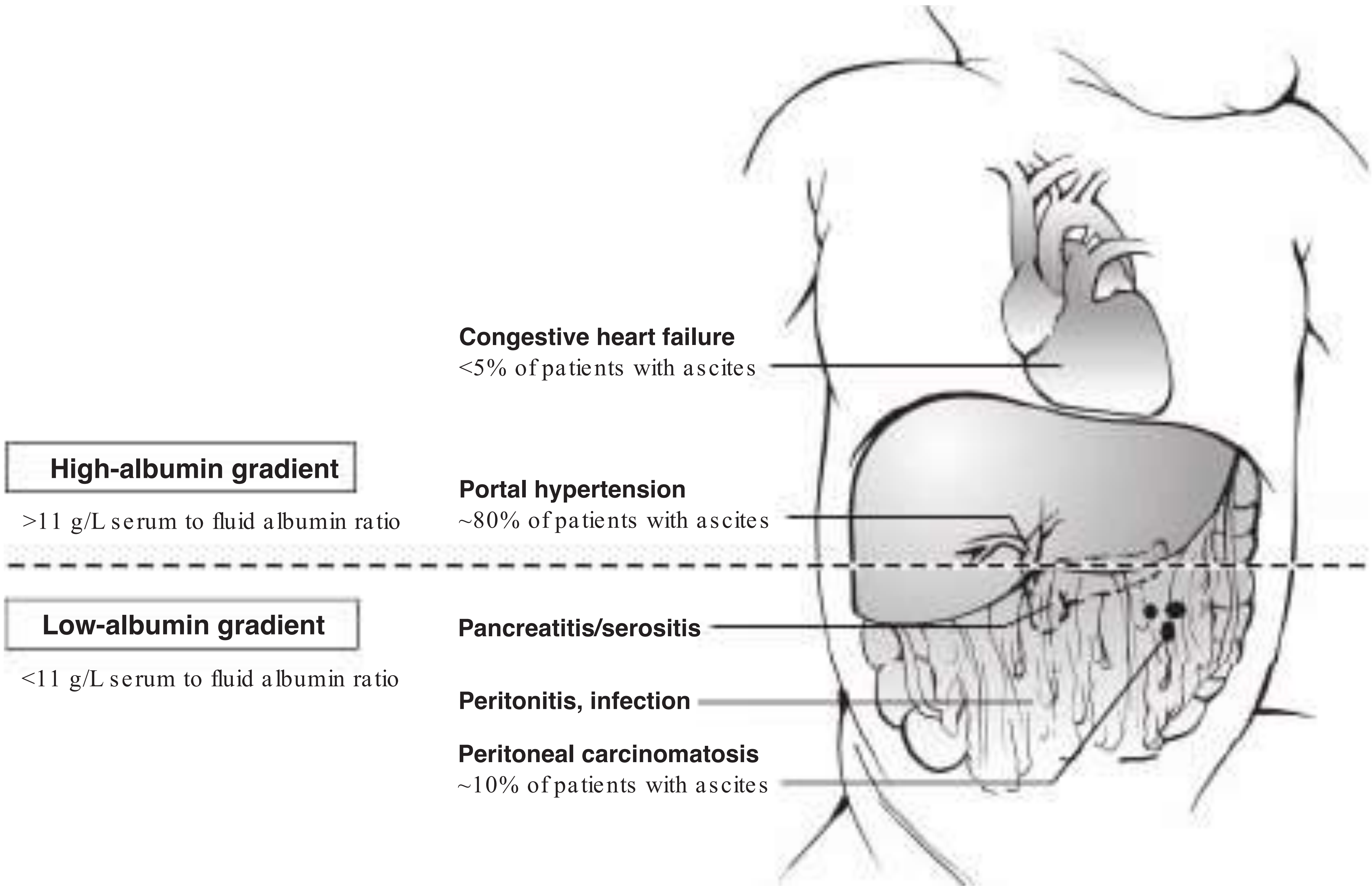

Congestive heart failure
<5% of patients with ascites
High-albumin gradient
>11 g/L serum to fluid albumin ratio
Portal hypertension
~80% of patients with ascites
Low-albumin gradient
<11 g/L serum to fluid albumin ratio
Pancreatitis/serositis
Peritonitis, infection
Peritoneal carcinomatosis
~10% of patients with ascites

Figure 8.1. Causes of ascites.

  - Peritonitis
  - Postoperative
  - Hypothyroidism
  - Hypokalemia
- Other
  - Fecal impaction
  - Irritable bowel syndrome
  - Flatus
  - Malabsorption

Abdominal/pelvic Mass (See Abdominal Mass)

- Pregnancy
- Ovarian mass
- Fibroids
- Bladder tumor
- Hepatosplenomegaly
- Malignancy
- Inguinal hernia
- Femoral hernia (especially in women)
- Postoperatively (seromas/hematomas)

APPROACH TO ABDOMINAL DISTENSION

History

- Determine the onset, duration, and accompanying symptoms such as abdo tenderness, obstipation, nausea, or vomiting
- If the patient is vomiting, inquire about the color, frequency and odour/character
- Inquire about a medical Hx of abdo surgery, cirrhosis or liver failure, cancer, hernias, alcohol abuse, or hepatitis

Physical Exam

- Begin the exam by obtaining the patient's vital signs. A hypotensive, tachycardic, or febrile patient in the setting of abdo distension is concerning for ischemic bowel or spontaneous bacterial peritonitis.
- Inspect the abdomen for surgical scars or signs of portal venous hypertension and cirrhosis such as caput medusae, spider nevi, palmar erythema, jaundice, icterus, etc.

- Auscultate the abdomen for hyperactive bowel sounds suggestive of mechanical bowel obstruction.
- Palpate the abdomen for any signs of guarding rebound or percussion tenderness. It is imperative to identify possible peritonitis. Assess for hepatosplenomegaly, hernias, and pelvic masses. Perform the shifting dullness test (see Clinical Box).

CLINICAL box

Shifting Dullness Test

- Percuss supine abdomen to determine areas of dullness
- Roll patient onto the left decubitus position
- Percuss previously outlined areas of dullness
- Shifting of dullness to areas of previous tympany suggests ascites

Investigations

- Routine blood work: serum hemoglobin, white cell count, platelets, electrolytes, liver enzyme tests (AST, ALT, ALP, and GGT), liver function tests (bilirubin, INR, albumin), as well as lipase (amylase is less useful in modern clinical practice).
- Serum lactate should be ordered if ischemic bowel is suspected, but the results should be interpreted with caution in septic patients, patients with chronic liver or kidney disease, or those who are volume-contracted.
- Every female patient within childbearing age should have a b-hCG test to exclude pregnancy.
- If the shifting dullness test is positive and the patient's clinical Hx is consistent with portal venous hypertension, then paracentesis should be ordered and the serum ascites albumin gradient (SAAG = albumin concentration of serum − albumin concentration of ascitic fluid) score should be calculated in addition to testing the fluid analyzed for albumin, white count, aerobic and anaerobic culture growth, and cytology (Figures 8.2 and 8.3).
- Routine imaging: three-view abdo x-rays to inspect for subdiaphragmatic free air, air-fluid levels, small bowel dilatation (remember 3-6-9 rule for maximum diameters—30 mm for small bowel, 60 mm for large bowel, and 90 mm for cecum), colonic volvulus, or fecal impaction.

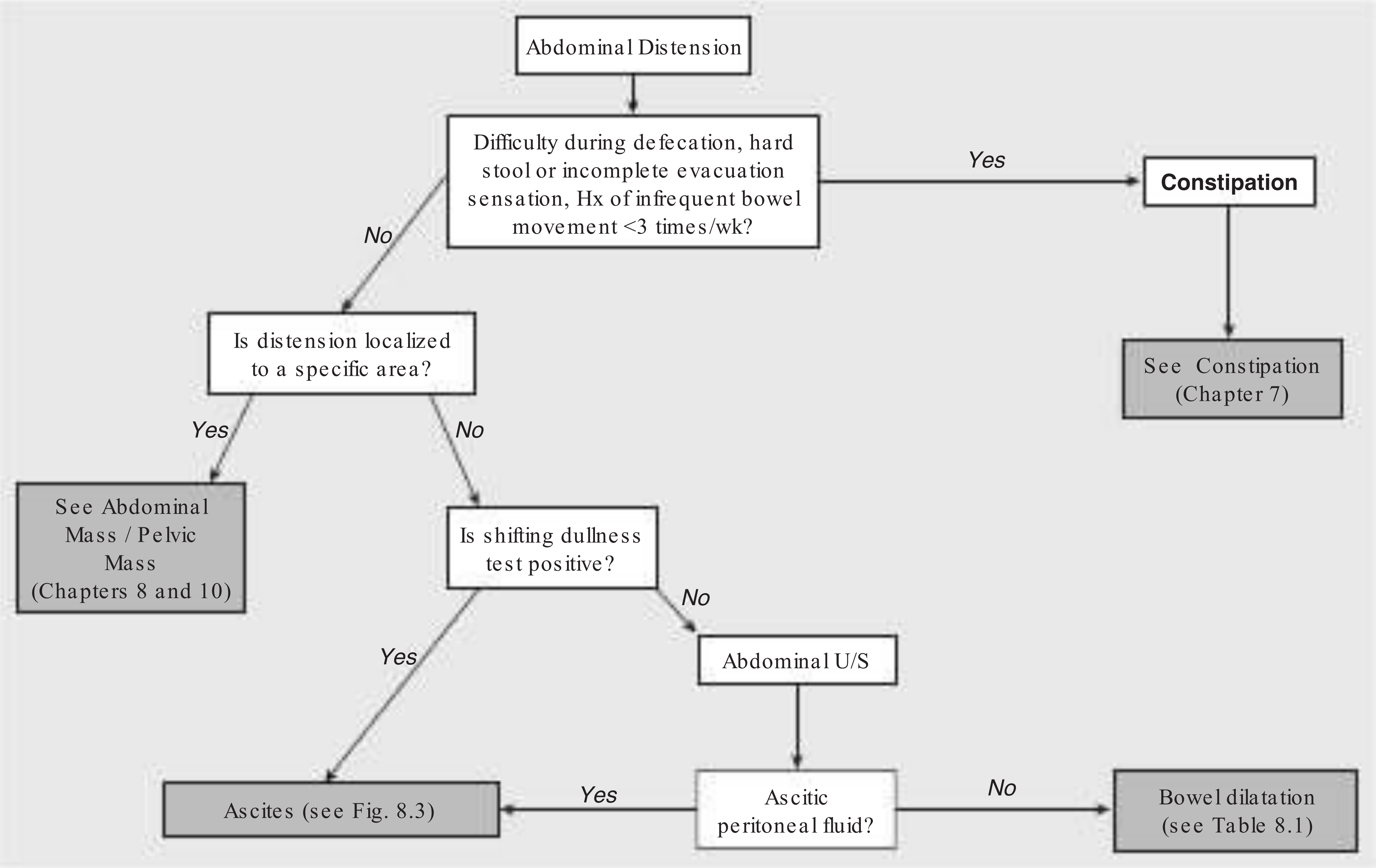

Abdominal Distension
Difficulty during defecation, hard stool or incomplete evacuation sensation, Hx of infrequent bowel movement <3 times/wk?
Yes
Constipation
See Constipation (Chapter 7)
No
Is distension localized to a specific area?
Yes
See Abdominal Mass / Pelvic Mass (Chapters 8 and 10)
No
Is shifting dullness test positive?
Yes
No
Abdominal U/S
Ascitic peritoneal fluid?
Yes
Ascites (see Fig. 8.3)
No
Bowel dilatation (see Table 8.1)

Figure 8.2. Approach to patient with distended Abdo.

- An abdo U/S is the next imaging modality of choice to assess for organomegaly, ascites, and abdominopelvic masses. CT scans offer a greater sensitivity and specificity for differentiating abdo pathology with the drawback of radiation exposure.

Diagnosis

- It is important to differentiate between acute and chronic causes of abdo distension using the patient's Hx, physical exam, blood work, and imaging tests.

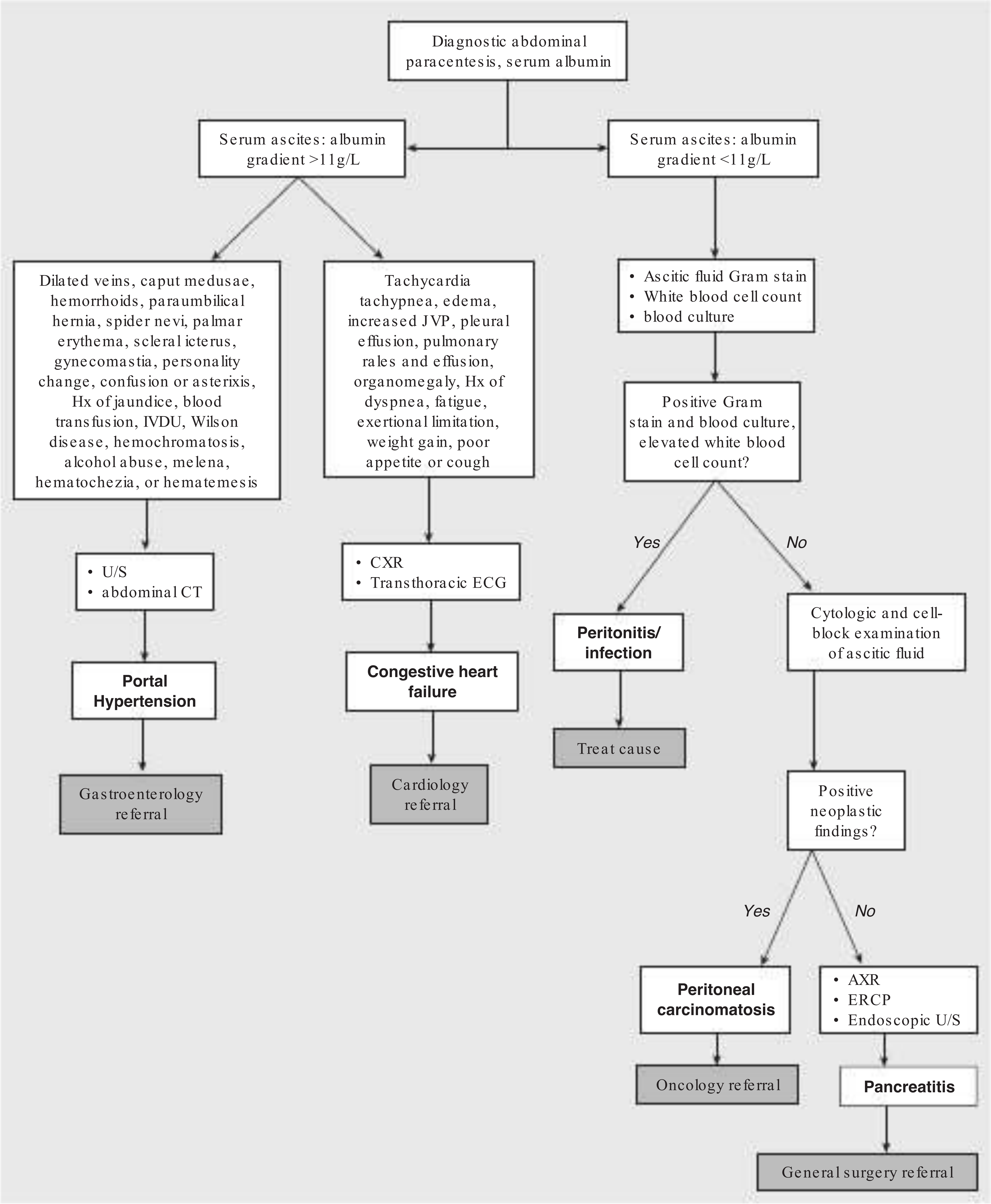

Diagnostic abdominal paracentesis, serum albumin
Serum ascites: albumin gradient >11g/L
Serum ascites: albumin gradient <11g/L
Dilated veins, caput medusae, hemorrhoids, paraumbilical hernia, spider nevi, palmar erythema, scleral icterus, gynecomastia, personality change, confusion or asterixis, Hx of jaundice, blood transfusion, IVDU, Wilson disease, hemochromatosis, alcohol abuse, melena, hematochezia, or hematemesis
Tachycardia tachypnea, edema, increased JVP, pleural effusion, pulmonary rales and effusion, organomegaly, Hx of dyspnea, fatigue, exertional limitation, weight gain, poor appetite or cough
• Ascitic fluid Gram stain
• White blood cell count
• blood culture
Positive Gram stain and blood culture, elevated white blood cell count?
• U/S
• abdominal CT
• CXR
• Transthoracic ECG
Yes
No
Portal Hypertension
Congestive heart failure
Peritonitis/ infection
Cytologic and cell-block examination of ascitic fluid
Gastroenterology referral
Cardiology referral
Treat cause
Positive neoplastic findings?
Yes
No
Peritoneal carcinomatosis
• AXR
• ERCP
• Endoscopic U/S
Oncology referral
Pancreatitis
General surgery referral

Figure 8.3. Approach to patient with ascites.

- A careful Hx and physical exam are often adequate to diagnose certain conditions such as adhesive bowel obstruction. It is important not to delay the management of sick patients with diagnostic tests.

Management

- Patients with mechanical small bowel obstruction should be promptly referred to a general surgeon. Most adhesive bowel obstructions will resolve with nonoperative management (typically "suck and drip," nasogastric decompression, and intravenous fluid resuscitation), but incarcerated, nonreducible hernias are emergencies. Other relative surgical urgencies include high-grade adhesive bowel obstructions.
- Patients with spontaneous bacterial peritonitis require prompt antibiotic coverage and referral to an internal medicine specialist or gastroenterologist to optimize the management of their portal venous hypertension. Care should be taken when resuscitating with crystalloid solution due to third-spacing secondary to hypoalbuminemia in many of those patients.
- Otherwise asymptomatic patients can be managed in the outpatient clinic setting with further diagnostic tests and treatment plans.
- See Table 8.1 for approach to patient with bowel dilation.

TABLE 8.1 • Approach to patient with bowel dilatation

Condition	Colicky Pain?	Signs/Sx	Workup	Management
Myopathic or neuropathic chronic intestinal pseudo-obstruction	+	Constipation, obstipation, N/V, anorexia, weight and muscle loss, distended bladder, mydriasis, ptosis, and external ophthalmoplegia, Hx of diabetes, amyloid disease, cancer, narcotic use, MS, spinal injury, or stroke	Antroduodenal manometry	Gastroenterology referral
Ogilvie syndrome	+	Hx of trauma, fractures, surgery, narcotics and anticholinergic medication use, spinal cord injury, cardiovascular disorder, or severe medical illness with long bed rest	Abdo x-ray—gross dilation of colon extending from cecum to rectum with no signs of obstruction	Gastroenterology referral. NPO. Colonoscopic decompression and rarely medical decompression with neostigmine (due to perforation risk)
Adhesions	+	Hx of abdominal surgery	AXR and usually CT Abdo/pelvis with oral contrast	NPO. NG if obstipated with N/V. General surgery referral
Large bowel obstruction	+	Diffuse tenderness, Hx of constant pain with intermittent to little vomiting	AXR and usually CT Abdo/pelvis with oral contrast	NPO. NG if obstipated with N/V. Urgent general surgery referral
Intussusception	+	Children may have current jelly stools, and a palpable mass. Adults do not have bloody stools as frequently, and may present indolently. Intussusception in adults is pathological until proven otherwise	1. U/S vs CT - Target sign 2. Abdo x-ray Dance sign (RUQ mass with RLQ empty space movement of cecum).	Urgent pediatric gastroenterology/general surgery referral for endoscopic reduction
Paralytic ileus	−	No bowel sounds on auscultation, no passage of flatus	Abdo x-ray	Bowel rest
Toxic megacolon	−	Fever, hypotension, tachycardia, leukocytosis, anemia, dehydration, altered mental status, electrolyte abnormality, Hx of IBD, recent travel, exposure to C. difficile or antibiotic use, chemotherapy, immunosuppression	Abdo x-ray. CT with contrast if stable	Treat cause. General surgery referral if condition worsens

+, present; −, absent.

- See Table 8.2 for cirrhotic versus malignant ascites

TABLE 8.2 • Cirrhotic versus malignant ascites

Ascites	Cirrhotic	Malignant
Treatment aim	Curative	Palliative
Paracentesis	Yes	Yes
Pharmacotherapy	Treatment of underlying disorder Steroids, antivirals (viral hepatitis), b-blockers, diuretics, broad-spectrum antibiotics (SBP/prophylactic use in some patients)	Chemotherapy, diuretics
Lifestyle modifications	Alcohol and smoking cessation, reduced sodium diet (< 2 g), and fluid intake	Subject to cancer management approach
Surgical intervention	None	Peritoneovenous shunting for refractive ascites
Liver transplant	May be beneficial	Not indicated

ABDOMINAL MASS

MCC OBJECTIVE

Based on Objective #2 (Abdominal/Pelvic Mass) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Abdo masses can be caused by organomegaly, neoplastic, and infective processes. It is important to promptly differentiate benign from malignant conditions and refer the patient for appropriate specialist care when indicated.

CAUSAL CONDITIONS

Organomegaly

- Hepatomegaly
- Splenomegaly
- Enlarged kidneys
  - Cysts
  - Hydronephrosis
  - Tumors

Neoplasms

- Lymphoma/sarcoma
- GI tumors
  - Gastric
  - GI stromal tumors
  - Pancreas
  - Colon
  - Hepatoma
- Gynecologic tumors
  - Ovarian
  - Uterine
- Neuroblastoma

Other

- Pelvic organ in the Abdo
  - Uterine or ectopic pregnancy
  - Distended bladder
- Pancreatic pseudocyst
- Abdo aortic aneurysm
- Abdo wall masses

CLINICAL box

Serum Tumor Markers

- Colonic
  - CEA
- Pancreatic
  - CEA, CA 19-9
- Hepatoma
  - AFP
- Ovarian
  - CA-125
- Germ line tumors
  - b-hCG
  - AFP

Approach

History

- A careful Hx is needed to differentiate between benign and malignant causes of abdo masses, with emphasis on personal or familial Hx of cancer and liver disease.
- Hx should also focus on separating possible etiologies based on symptoms: GI (N/V, changes in bowel habits) and GU symptoms (difficulty urinating, gross hematuria) (Figure 8.4).
- Assess for Hx of weight loss, night sweats, or fevers consistent with cancer.
- The onset and course of the mass should be noted. Rapidly growing abdo masses are more concerning than stable, incidentally noted ones.
- A pulsating abdo mass is concerning for an enlarged abdo aortic aneurysm.

CLINICAL box

Signs of Symptomatic abdo Aortic Aneurysm

1. General diffuse Abdo, low back or flank pain
2. Pulsatile paraumbilical mass
3. Systolic bruit over the abdo aorta
4. Tenderness over affected area on palpation
5. Abdo fullness sensation
6. Leg swelling

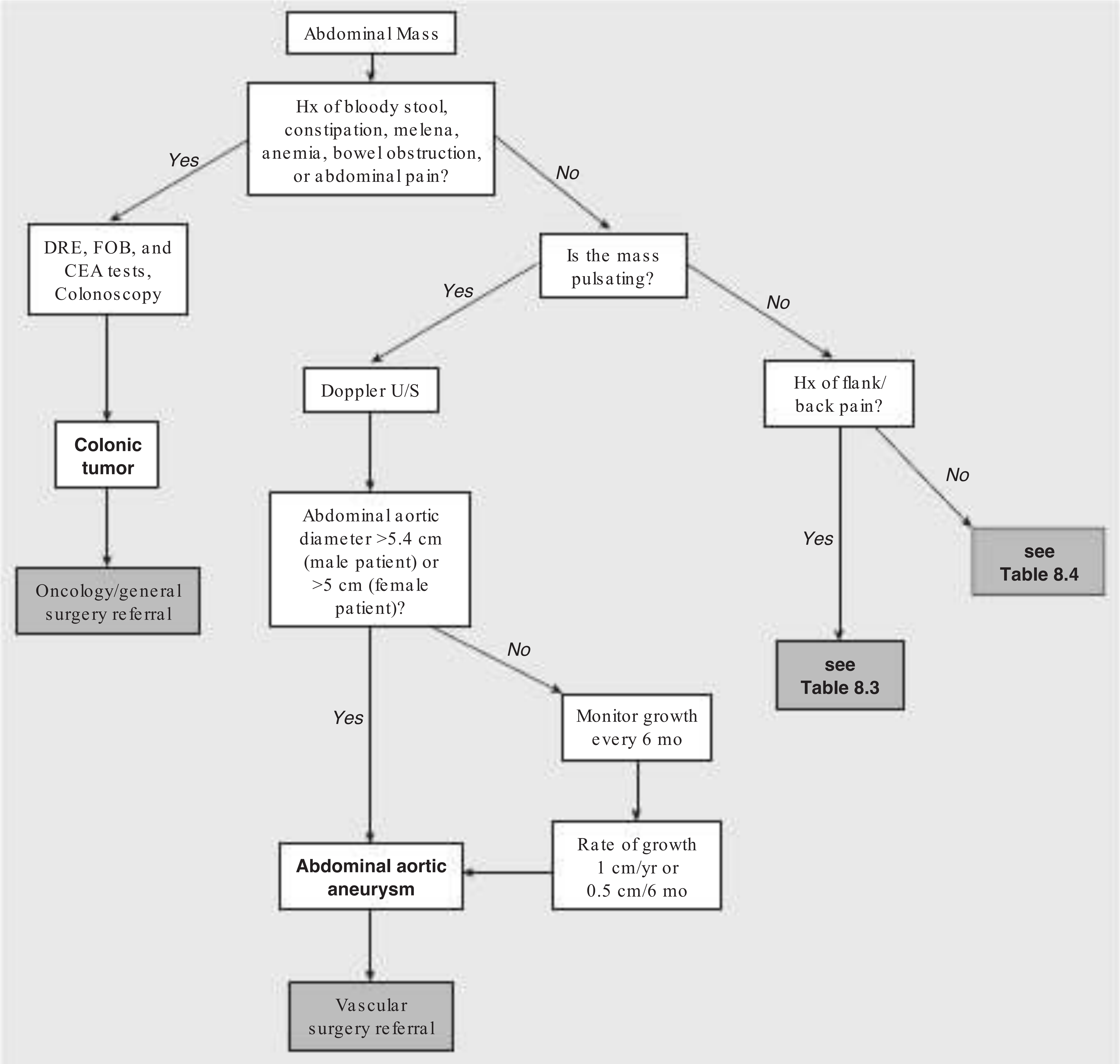

Abdominal Mass
Hx of bloody stool, constipation, melena, anemia, bowel obstruction, or abdominal pain?
Yes
No
DRE, FOB, and CEA tests, Colonoscopy
Colonic tumor
Oncology/general surgery referral
Is the mass pulsating?
Yes
No
Doppler U/S
Abdominal aortic diameter >5.4 cm (male patient) or >5 cm (female patient)?
Yes
No
Monitor growth every 6 mo
Rate of growth 1 cm/yr or 0.5 cm/6 mo
Abdominal aortic aneurysm
Vascular surgery referral
Hx of flank/ back pain?
Yes
No
see Table 8.3
see Table 8.4

Figure 8.4. Approach to patient with abdo mass.

Physical Exam

- Assess the location, size, and quality of the mass (e.g., firm, soft, tender)
- Assess for concurrent signs suggestive of cirrhosis and concurrent portal venous hypertension, such as caput medusae or palmar erythema
- Identify possible surgical scars, incisional hernias, and recent postoperative seromas/hematomas

TABLE 8.3 • Approach to abdo mass in patient with flank or back pain

Condition	Signs/Sx	Workup	Management
Renal tumor	Hx of hematuria, hypertension	Kidney U/S, abdo CT	Urology referral
Gastric tumor	Hx of bloating, premature satiety, dysphagia, anorexia, melena, hematemesis, and epigastric pain	FOB test, double contrast radiographic examination ± endoscopy	General surgery ± thoracics referral
Renal cyst	Hx of nephrolithiasis, hematuria, renal infection, polyuria, end-stage renal disease, renal failure, hypertension, dialysis	Kidney U/S and CT	Nephrology referral
Hydronephrosis	Hx of N/V, worsening pain with consumption of fluids, radiates to ipsilateral testes/labia, hematuria	Kidney U/S and CT	Nephrology referral
Sarcoma	Rapidly enlarging mass. Lower extremity edema, Hx of dysphagia, constipation, melena, nonspecific abdo pain, early satiety, or sensation of fullness	CT/MRI	Oncology referral

TABLE 8.4 • Approach to abdo mass by location

Condition	Anatomical Location	Signs/Sx	Workup	Management
Hepatomegaly	Right subcostal area	Palpable lower border of liver, liver span > 12 cm	Hepatic U/S and CT	See Chapter 7—Hepatology
Hepatic Mass	Right subcostal area	Jaundice, scleral icterus, deep palpation-induced pain, Hx of right shoulder pain Decompensation of stable cirrhosis	AFP serology, contrast CT, routine U/S for high-risk patients	General surgery referral
Pancreatic tumor	Epigastrium, left subcostal area	Nausea/vomiting, anorexia, weight loss, obstructive jaundice. Recent onset of diabetes mellitus, darkening urine, changing stool color	CA 19-9 serology, abdo U/S and CT	General surgery referral
Pancreatic pseudocyst	Left subcostal area	Hx of acute or chronic pancreatitis, abdo trauma	Abdo U/S and contrast CT	General surgery referral if significant nausea and abdo pain
Splenomegaly	Left subcostal area	Positive Castell sign, palpable spleen	CT scan and possible PET scan if indicated	See Chapter 11—Splenomegaly
Uterine tumor	Suprapubic area	Hx of abnormal vaginal bleeding ± discharge	Endometrial biopsy	Gynecology referral
Ovarian tumor	Suprapubic area	Hx of abdo pain, bloating, irregular menses, or change in bowels	Transvaginal U/S CA-125 serology	Gynecology referral
Pregnancy	Suprapubic area	Hx of fatigue, breast tenderness or enlargement, N/V, increased urination, amenorrhea	hCG test, suprapubic U/S	See Chapter 14 — Antepartum Care
Enlarged bladder	Suprapubic area	Hx of urinary frequency, dysuria, change in urine appearance	Bladder U/S	Treat cause See Chapter 23
Neuroblastoma	Crosses the midline	Irregular abdo mass, exclusively in pediatric patients	CBC, ESR, AXR, and CT	Oncology referral

Investigations

- Routine blood work: serum hemoglobin, white cell count, platelets, electrolytes, liver enzyme tests (AST, ALT, ALP, and GGT), liver function tests (bilirubin, INR, albumin), as well as lipase (amylase is less useful in modern clinical practice).

- Every female patient within childbearing age should have a b-hCG test to exclude pregnancy.
- Routine imaging: U/S followed by CT scan of the abdo with oral as well as IV contrast, if needed.
- A tumor suspicious for malignancy should be biopsied with fine needle aspiration or core needle biopsy. A possible intraluminal mass will need to be biopsied via endoscopy. Pancreatic or biliary sources may be accessed via an ERCP (Table 8.5).

TABLE 8.5 • Biopsies

	Type of Biopsy			
Pathologic Condition	Percutaneous	Endoscopic	Laparoscopic	Endometrial
Hepatomegaly	X			
Enlarged kidneys	X			
Lymphomas[a]	X	X	X	
Sarcomas[a]	X	X	X	
Gastrointestinal cancers		X		
Ovarian cancer			X	
Uterine cancer				X
Neuroblastoma	X			
Abdo wall mass	X			

X is a checkmark to indicate biopsy performed.

Biopsies are not indicated for pelvic organ enlargement or in abdo aortic aneurysms.

[a] Type of biopsy used depends on mass location.

Diagnosis

- The diagnosis is established after a careful Hx, physical exam, blood work, imaging, and biopsy results are obtained.

Management

- Benign causes of abdo organomegaly such as cirrhosis and idiopathic thrombocytopenic purpura should be referred to an internist for medical optimization.
- Malignant causes of abdo organomegaly should be referred to a general surgeon for management.
- Patients with abdo aortic aneurysms should be referred to a vascular surgeon for management.
- Renal cysts < 3 cm in diameter require no further intervention, whereas cysts > 3 cm carry a 5% to 10% malignancy risk and require routine follow-up with imaging (U/S or CT scans).

ABDOMINAL AND GROIN HERNIAS

MCC OBJECTIVE

Based on Objective #2-4 (Hernia [Abdominal Wall and Groin]) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Hernias are defects in the abdominal wall or other anatomical structures leading to protrusions of peritoneal structures from their containing cavities. Hernias could be **reducible or nonreducible, obstructed, incarcerated, or strangulated.** Generally, large hernias are less likely to become nonreducible and incarcerated compared with smaller hernias.

APPLIED SCIENTIFIC CONCEPT

Indirect inguinal hernias are more common in males due to failure in **processus vaginalis** closure during embryogenesis.

CAUSAL CONDITIONS (Figure 8.5)

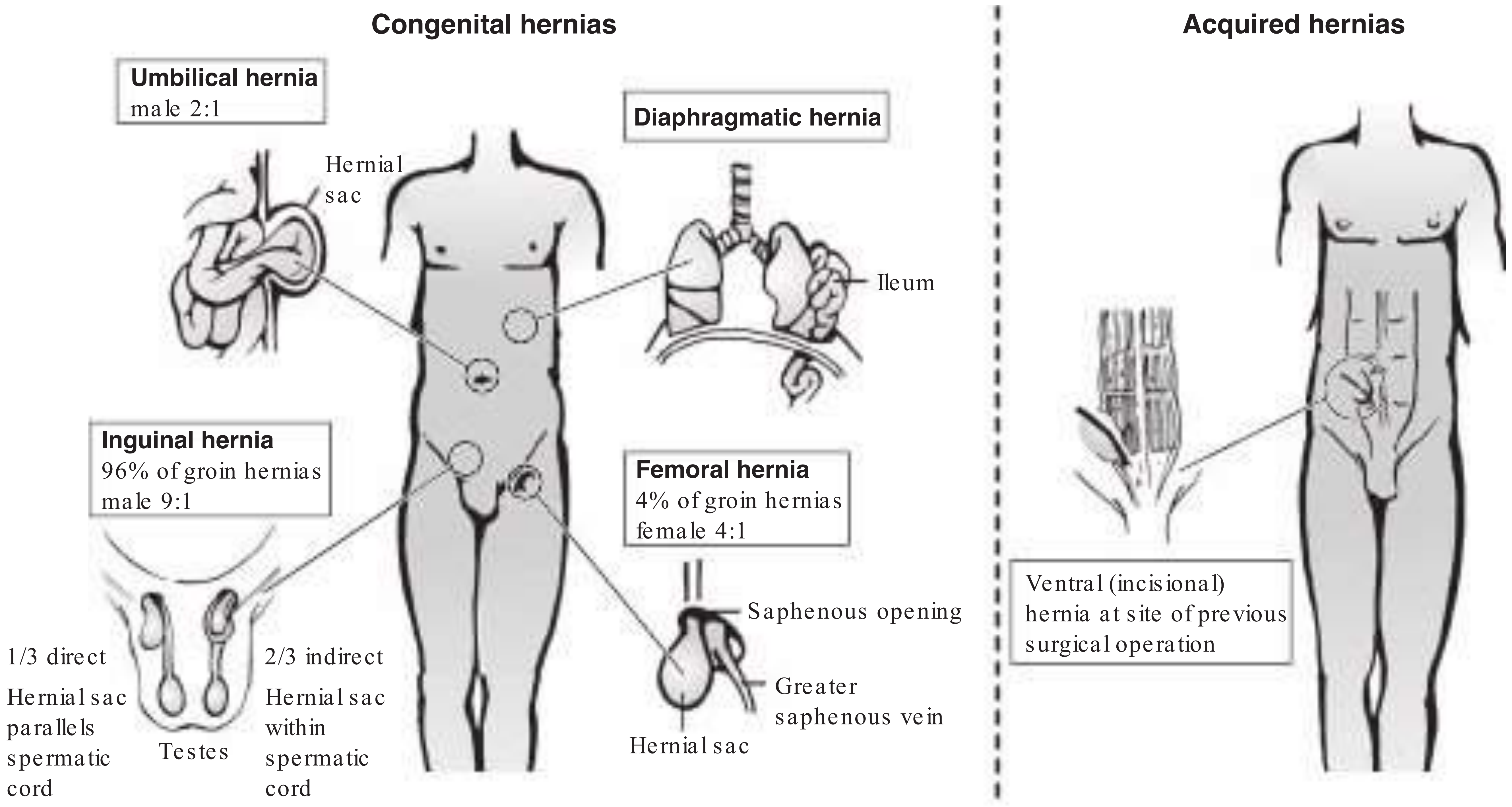


Figure 8.5. Causal conditions of hernia.

APPROACH

History

- Inquire about personal or familial Hx of hernias and rule out other causes for palpable abdo wall masses (e.g., lymphadenopathy, undescended testicle)

Physical Exam (Figure 8.6)

- Perform a careful physical exam, including a cough impulse, to determine the location, size, and character of the hernia, and the presence of other undiagnosed hernias. Inspect for signs of surgical scars to explain a potential ventral hernia.

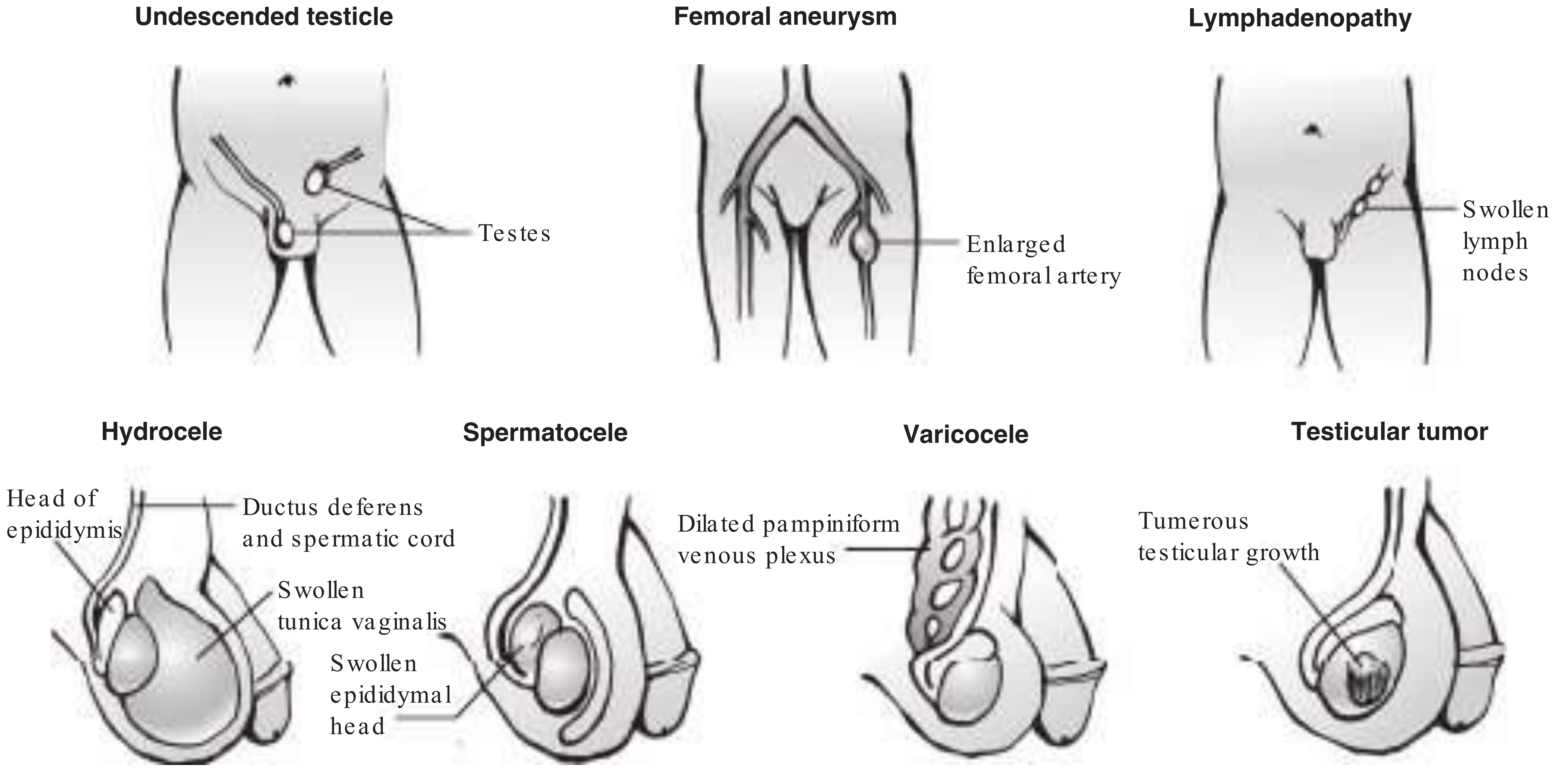


Figure 8.6. Differential diagnosis of a mass in the groin.

- The proper position for examining inguinal hernias is the upright standing position. The hernia will present at the location of the superficial inguinal ring (external inguinal ring). An exam for the presence of a patent process vaginalis should be performed.

Investigations

- No routine blood work is needed in the workup of a hernia.
- A U/S study is useful in establishing a diagnosis of a groin hernia; however, surgical/symptomatic groin hernias should be apparent on exam.

Management

- All hernias should be assessed by a general surgeon for consideration of repair due to the risk of incarceration and strangulation.
- A patient who presents with a nonreducible hernia in the setting of increased pain or signs of hemodynamic instability should undergo urgent operative exploration. Referral to a general surgeon should not be delayed by investigations or imaging studies.
- Factors that influence postoperative recurrence include:
  - Aberrant collagen states or metabolic disorders (e.g., Ehlers-Danlos syndrome)
  - Compromised tissue healing (e.g., malnutrition or suppressed immunity)
  - Increased intra-abdo pressure (e.g., obesity or ascites chronic straining (BPH, constipation), chronic cough))
  - Repair failure: (e.g., postoperative infection, inadequate repair)

CLINICAL box

Common Types of hernia

Indirect inguinal: sac lies within the spermatic cord.

Direct inguinal: sac parallels the spermatic cord.

Femoral hernia: sac descends through the femoral canal beneath the inguinal ligament.

ACUTE ABDOMINAL PAIN

MCC OBJECTIVE

Based on Objective #3-2 (Acute Abdominal Pain) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Acute abdo pain (< 6 h) can either be sudden in onset or an exacerbation of chronic pain. It has an extensive differential diagnosis that includes surgical and nonsurgical etiologies originating from the abdo cavity or referred from the chest, pelvis, or back.

APPLIED SCIENTIFIC CONCEPT

Visceral pain originates from triggering the autonomic nervous system innervating the visceral peritoneum. It is typically characterized as dull, vague, and deep. **Parietal** pain originates from triggering the spinal somatic nerves innervating the parietal peritoneum. It is typically characterized as localized and sharp/stabbing.

CAUSAL CONDITIONS

Abdominal

- Rectus muscle hematoma
- Abdo muscle spasm
- Abdo aortic aneurysm
- Perforated viscus
- Small bowel obstruction
- Bacterial peritonitis
- Gastroenteritis
- Ulcer (gastric or duodenal)
- Inflammatory bowel disease
- Irritable bowel syndrome
- Constipation
- Pancreatitis
- Hepatitis
- Biliary tree disease (biliary colic, cholangitis, cholecystitis)
- Splenic infarct
- Appendicitis
- Diverticulitis

CLINICAL box

Causes of abdo pain in Special Patients

Elderly

- Biliary tract disease
- Malignancy
- Bowel obstruction
- Complications of peptic ulcer disease
- Hernia-related pain

Immunocompromised Patients

- Graft-versus-host disease
- Cytomegalovirus infection
- Neutropenic enterocolitis

- Pelvic inflammatory disease
- Ovarian torsion
- Ectopic pregnancy
- Hemorrhagic ovarian cyst
- Endometriosis
- Nephrolithiasis
- Hydronephrosis
- Urinary tract infection

Genitourinary

- Testicular torsion

Infectious

- Herpes zoster

Metabolic

- Ketoacidosis (alcoholic or diabetic)
- Porphyria
- Sickle cell disease

Thoracic

- Myocardial infarction
- Pneumonia
- Pulmonary embolism
- Radiculitis

Toxic

- Heavy metal poisoning
- Methanol poisoning
- Venom (scorpion or black widow spider)

Approach

History

- Determine the onset, duration, character, localization, relieving and exacerbating factors, and Hx of similar pain (Figure 8.7).
- Determine the medical history with an emphasis on Hx of infection, cancer, metabolic abnormalities, recent travel, and any other medical or surgical Hx.

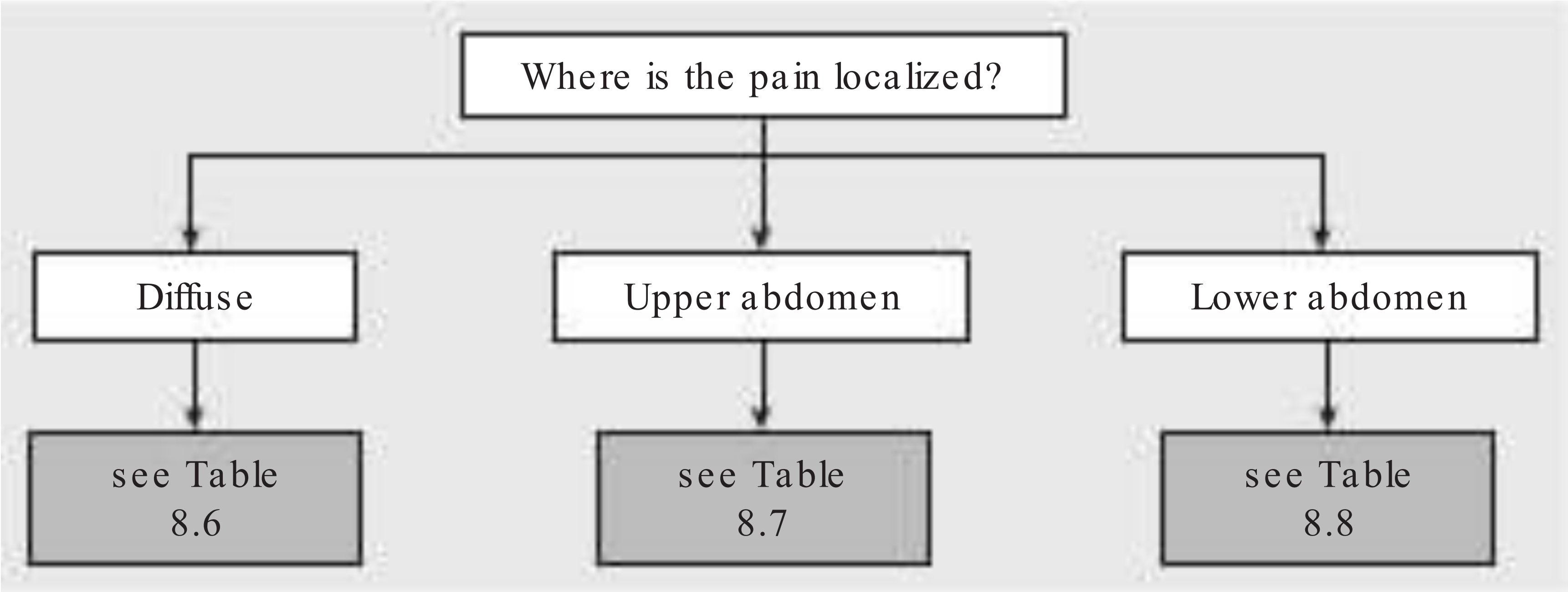


Figure 8.7. Approach to patient with acute abdo pain.

Physical Exam

- Begin the exam by obtaining the patient's vital signs. A hypotensive, tachycardic, or febrile patient in the setting of abdo pain is concerning for ischemic bowel, a rupturing abdo aortic aneurysm, or a septic process.
- Inspect the abdomen for surgical scars, rashes, or a pulsating abdo mass.
- Auscultate the abdomen for hyperactive bowel sounds suggestive of mechanical bowel obstruction.
- Palpate the abdomen for any signs of guarding or rebound tenderness. Assess for hepatosplenomegaly, hernias, and pelvic masses.
- Examine the chest, precordium, flanks, back, and genitalia (in a male).

TABLE 8.6 • Approach to patient with diffuse abdo pain

Condition	Peritoneal Signs?	Clinical Onset	Other Signs	Workup	Management
Ruptured aneurysm	+	Sudden	Tearing abdo and lumbar pain, pulsating periumbilical mass, hypotension	CT. Aortogram if stable	Urgent vascular surgery referral
Perforated viscus	+	Severe sudden or gradual colicky abdo pain, *or diverticular disease Hx of ulcer, *occult blood stool	May present with SIRS/shock	AXR. abdo CT if stable	Urgent general surgery referral
Small bowel obstruction	+	Intermittent, colicky, postprandial	Recurring cramps every 3–10 min, vomiting, crescendo–decrescendo rushes of high-pitched peristalsis sounds coincident with pain onset. Hx of surgery	Abdo x-ray and usually abdo CT	Urgent general surgery referral
Bacterial peritonitis	+	Sharp, constant	Pain worsened by movement, presence of ascites, Hx of cirrhosis, fever, altered mental status	Paracentesis of ascitic fluid	Treat cause Broad-spectrum antibiotics initially
Gastroenteritis	−	Diarrhea with cramping pain Vomiting usually occurs before onset of pain	Vomiting. Hx of contaminated food or water consumption or travel, poor skin turgor, orthostatic, or generalized hypotension	Blood and stool bacterial cultures	Treat cause
Irritable bowel syndrome	−	Episodic crampy pain in at least 12 wk, which need not be consecutive in the preceding 12 mo	2/3 of the following: relieved by defecation, onset associated with changes in stool frequency, onset associated with changes in stool form	None	Education, reassurance, dietary/lifestyle changes. Gastroenterology if condition worsens
Constipation	−	Sudden or gradual	Hx of infrequent bowel movement < 3/wk, difficulty during defecation	See Chapters 7 & 18—Adult/Pediatric Constipation	
Ketoacidosis	−	More common in DM1, often insidious in onset, often associated with intercurrent illness or physiological stress	Nausea, vomiting, polydipsia, polyuria, abdominal pain, hyperglycemia, hypotension, tachycardia. Fruity breath, Kussmaul breathing	Urinalysis, blood work—CBC, electrolytes, creatinine, glucose Investigate for underlying cause	Treat cause See Chapter 6

+ , present; −, absent.

TABLE 8.7 • Approach to patient with upper abdo pain

Condition	Peritoneal Signs?	Clinical Onset	Other Signs	Workup	Management
Pancreatitis	+	Constant midepigastric pain, radiates to left shoulder region and back, worsens with supine position	N/V, tachycardia, hypotension, hypoxemia, Hx of alcohol abuse, gallstones, medication use	Abdo U/S, serum enzyme tests—lipase. Ranson criteria for prognostication (on admission and 48 h)	Treat cause See Chapter 7 Gallstone pancreatitis will be treated with a laparoscopic cholecystectomy - often on the same admission

(continued)

TABLE 8.7 • Continued

Condition	Peritoneal Signs?	Clinical Onset	Other Signs	Workup	Management
Cholangitis	+	RUQ pain	Jaundice, fever (Charcot triad), signs of CNS depression, hypotension (Reynold's Pentad)	Abdo U/S, liver chemistries (AST, ALT, ALP, GGT), bilirubin, lipase, CBC, CRP	Gastroenterology referral
Cholecystitis	+	RUQ pain rising over 2–3 min to an intense plateau that is maintained for > 20 min, radiates to shoulder or back	Recurrent attacks 1–6 h after meals lasting > 12 h, positive Murphy sign May feel like biliary colic type pain that does not resolve	Abdo U/S, liver chemistries (AST, ALT, ALP, GGT), bilirubin, lipase, CBC, CRP	General surgery referral
Appendicitis[a]	+	Dull ache and tenderness along McBurney point (migratory Hx)	Anorexia, N/V, guarding, positive Rovsing, psoas, and obturator signs	U/S or abdo CT	General surgery referral
Peptic ulcer disease/gastritis	−	Burning epigastric pain after eating, relieved by food and antacids	Hx of belching, bloating, abdo distension, food intolerance, chronic NSAID/aspirin use	CBC, gastroscopy. Test for H. pylori (breath test, serology, stool antigen test, biopsy)	Treat cause See Chapter 7
Acute hepatitis	−	RUQ pain	Hepatomegaly, jaundice, Hx of anorexia, N/V, fatigue, malaise, arthralgias, myalgias, headache, photophobia, pharyngitis, cough, and/or coryza	Liver chemistries—AST, ALT, ALP, GGT. INR/PTT, albumin, bilirubin Investigations for possible underlying cause. See Chapter 7	Gastroenterology referral Hepatology if synthetic dysfunction/acute liver failure
Biliary colic	−	Progressive aching, cramping epigastric, or RUQ pain a few hours after a meal and lasting 0.5–6 h	No signs of systemic disease	Abdo U/S, liver chemistries (AST, ALT, ALP, GGT), bilirubin, lipase, CBC, CRP	Supportive treatment. General surgery referral if condition worsens
Splenic rupture	−	LUQ pain	Hx of Trauma, positive Kehr sign (acute pain in tip of left shoulder)	FAST U/S in trauma Abdo CT	General surgery referral
Splenic infarction	−	LUQ pain and tenderness	Fever, splenomegaly, Hx of hypercoagulable state, embolic disease, trauma, malignant hematologic conditions, hemoglobinopathy, or immunosuppression	Abdo CT	General surgery referral
Gastroesophageal reflux disease	−	Epigastric pain	Hx of heartburn, regurgitation of digested food, angina-like chest pain	Treat empirically Endoscopy if concerning Sx Ph monitoring + esophageal impedance if empirical therapy fails	Education, reassurance, dietary/lifestyle changes, trial PPI; gastroenterology referral if condition worsens
Hepatic abscess	−	RUQ pain	Fever, chills, nausea, anorexia, and weight loss	Abdo CT, CBC, liver chemistries, INR/PTT, albumin, bilirubin	IR for drainage of abscess if accessible. General surgery referral

+ , present; −, absent.

[a] Appendicitis typically presents as diffuse central abdo pain that later localizes to the RLQ.

TABLE 8.8 • Approach to patient with lower abdo pain

Condition	Peritoneal Signs?	Clinical Onset	Other Signs	Workup	Management
Diverticulitis	+	Persistent LLQ pain	Abdo distension, N/V, constipation, anorexia, fever	Abdo CT	General surgery referral
Appendicitis[a]	+	Dull ache and tenderness along McBurney point (migratory Hx)	Anorexia, N/V, guarding, positive Rovsing, psoas, and obturator signs	U/S or CT Abdo	General surgery referral
Incarcerated hernia	−	Lower abdo pain	Painful enlargement of previous hernia, abdo distension, N/V, obstipation, anorexia	U/S or CT abdo although not always necessary	General surgery referral
Ectopic pregnancy	+	Sudden cramping genital pain in pregnant female patient	Vaginal bleeding, hemodynamic instability	Pelvic U/S, b-hCG	Urgent OB/GYN referral
Pelvic inflammatory disease/ salpingitis	±	Lower Abdo, bilateral adnexal, and cervical motion tenderness	Temperature > 38°C, cervical/vaginal discharge	Pelvic U/S, pap smear, CBC	Urgent OB/GYN referral
Ovarian torsion	±	Sudden, severe unilateral lower abdo pain that worsens intermittently, breast tenderness, N/V, fatigue, abdo distension	N/V, fever, Hx of recent strenuous physical activity	Pelvic U/S (transabdominal/ transvaginal with Doppler)	Urgent OB/GYN referral
Mesenteric lymphadenitis	−	Mild RLQ pain	N/V before pain onset, fever, diarrhea, anorexia, current or Hx of URTI	Abdo CT	General surgery referral
Psoas abscess	−	Lower abdo pain	Fever, limitation of hip movement (patient prefers to be supine, knee flexed, hip externally rotated), Hx of Crohn disease, diverticulitis, or appendicitis	Abdo CT	General surgery referral (drainage and Abx [most common pathogen is S. aureus])
Inflammatory bowel disease	−	Crampy RLQ pain	Diarrhea, rectal bleeding, tenesmus, occult blood loss, anemia, weight loss, fever	Abdo CT	Gastroenterology referral
Renal colic	−	Lower abdo aching pain Intermittent sudden onset of severe flank pain originating at the costovertebral angle and radiating anteriorly in waves to the groin	Dysuria, urgency, urge incontinence, hematuria, CVA tenderness, N/V. With obstruction may have infection/pyelonephritis and associated Sx such as fever	Urinalysis, creatinine urine culture, and abdo CT KUB	Urology referral—See Chapter 23
UTI	−	Subrapubic tenderness	Dysuria, urgency, frequency, hematuria	Urine analysis, creatinine, urine culture	Nephrology consult
Pyelonephritis		Flank tenderness	Pyelonephritis also has fever, CVA tenderness, and nausea/vomiting.	CT Abdo/U/S in pediatric population	Surgical consult for abscess, calculi-related UTI, renal papillary necrosis, Xanthogranulomatous pyelonephritis

[a] Appendicitis typically presents as diffuse central abdo pain that later localizes to the RLQ.

CLINICAL box

Cholecystitis (Murphy Sign)

Inspiratory arrest secondary to RUQ costal margin palpation in supine patient

Investigations

- Routine blood work: serum hemoglobin, white cell count, platelets, electrolytes, liver enzyme tests (AST, ALT, ALP, and GGT), liver function tests (bilirubin, INR, albumin), as well as lipase (amylase is less useful in modern clinical practice).
- Consider obtaining lactate and arterial blood gases in a hemodynamically unstable patient.
- Every female patient within childbearing age should have a b-hCG test to exclude ectopic pregnancy.
- Routine imaging: three-view abdo x-rays to inspect for subdiaphragmatic free air, air-fluid levels, small bowel dilatation, colonic volvulus, or fecal impaction.
- If a patient is hemodynamically stable, then an abdo U/S is the next imaging modality of choice to assess for cholecystitis, choledocolithiasis, appendicitis, hydronephrosis, and ectopic pregnancy. CT scans offer a greater sensitivity and specificity for differentiating abdo pathology with the drawback of radiation exposure. Typically oral and IV contrast will be administered.

Diagnosis

- It is important to differentiate between surgical and nonsurgical causes of abdo pain using the patient's Hx, physical exam, blood work, and imaging tests.

Management

- Hemodynamically unstable patients require prompt resuscitation with crystalloid intravenous solutions, broad-spectrum antibiotics (if sepsis is suspected), and transfer to a monitored setting in the emergency department or intensive care unit. A surgical consult should be promptly obtained in an unstable patient with acute abdo pain.

ANORECTAL PAIN

MCC OBJECTIVE

Based on Objective #3-4 (Anorectal Pain) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Anorectal pain can be secondary to a distal GI tract, dermatologic, and infectious etiologies. Prompt and appropriate diagnosis and management help control the significant morbidity in this patient population.

CAUSAL CONDITIONS

Anorectal Disease

- Abscess
- Fistula
- Fissure
- Hemorrhoids (internal and external)
- Rectal prolapse
- Chemotherapy
- Neuropathy

Dermatologic

- Psoriasis
- Contact/atopic dermatitis
- Malignancy
- Ulcer

Infectious

- Bacterial
- Fungal
- Viral
- Parasitic

Other

- **Psychological**
- Coccygeal pain

CLINICAL box

Infectious Agents

Sexually Transmitted

- *N gonorrhoeae*
- *C trachomatis*
- HSV
- Syphilis

Bacteria

- *Salmonella*
- *C difficile*
- *Shigella*
- *Campylobacter*

Fungi

- *Tinea* (ringworm)

Parasites

- *E vermicularis* (pinworm)

- Trauma
- Pelvic floor muscle syndrome

APPROACH (Figure 8.8)

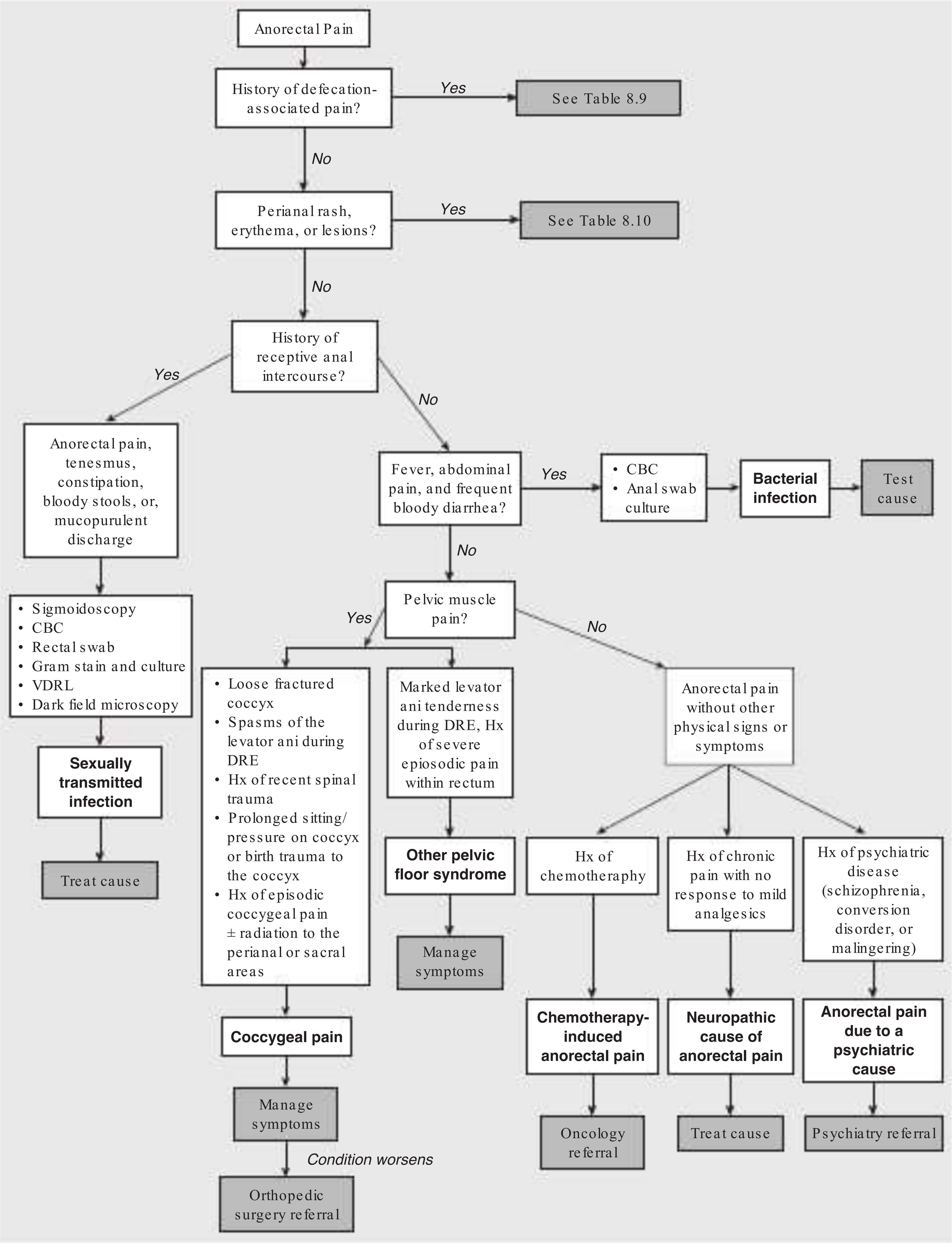

Anorectal Pain
History of defecation-associated pain?
Yes
See Table 8.9
No
Perianal rash, erythema, or lesions?
Yes
See Table 8.10
No
History of receptive anal intercourse?
Yes
Anorectal pain, tenesmus, constipation, bloody stools, or, mucopurulent discharge
• Sigmoidoscopy
• CBC
• Rectal swab
• Gram stain and culture
• VDRL
• Dark field microscopy
Sexually transmitted infection
Treat cause
No
Fever, abdominal pain, and frequent bloody diarrhea?
Yes
• CBC
• Anal swab culture
Bacterial infection
Test cause
No
Pelvic muscle pain?
Yes
• Loose fractured coccyx
• Spasms of the levator ani during DRE
• Hx of recent spinal trauma
• Prolonged sitting/ pressure on coccyx or birth trauma to the coccyx
• Hx of episodic coccygeal pain ± radiation to the perianal or sacral areas
Coccygeal pain
Manage symptoms
Condition worsens
Orthopedic surgery referral
Marked levator ani tenderness during DRE, Hx of severe epiosodic pain within rectum
Other pelvic floor syndrome
Manage symptoms
No
Anorectal pain without other physical signs or symptoms
Hx of chemotheraphy
Chemotherapy-induced anorectal pain
Oncology referral
Hx of chronic pain with no response to mild analgesics
Neuropathic cause of anorectal pain
Treat cause
Hx of psychiatric disease (schizophrenia, conversion disorder, or malingering)
Anorectal pain due to a psychiatric cause
Psychiatry referral

Figure 8.8. Approach to patient with anorectal pain.

TABLE 8.9 • Approach to patient with defecation-associated pain

Diagnosis	Anorectal Fistula	Anorectal Abscess	Anal Fissures	External Hemorrhoids
Description	One or more perianal openings, palpable cord-like perianal tract, Hx of previous abscesses, intermittent or constant purulent or serous discharge from perianal opening	Tender anorectal mass, fever; DRE reveals a tender fluctuant mass on rectal wall. Hx of continuous deep seated pain and rectal discomfort that worsens with ambulation or straining	Anal canal tear along posterior or anterior midline, bleeding, hypertrophic papillae, skin tags, Hx of hard, large, painful stools, "knife-like" pain lasting up to several hours post defecation	Painful, bluish perianal swellings, skin tags, sensation of incomplete defecation, pruritus, bloody stools, or prolapsed mass. Hx of pregnancy, constipation, anoscopy shows anal swellings
Management	General surgery referral	Urgent general surgery referral	Manage Sx	Manage Sx Surgical referral if refractory

TABLE 8.10 • Approach to patient with perianal rash, erythema, or lesions

Diagnosis	Psoriasis	Contact Dermatitis	Atopic Dermatitis	HPV	Malignancy	Fungal Infection
Clinical presentation	Sharply demarcated inflamed, bright red pruritic perianal lesions	Papulovesicles with surrounding erythema, weeping and crusted lesions, Hx suggestive of chronic contact with potentially allergic agents (e.g., latex condoms, sanitary wipes)	Generalized xerosis, erythematous, lichenified, pruritic patches and papules. Hx of asthma, allergic rhinoconjunctivitis	Single or multiple papillary eruptions, Hx of receptive anal activity, immuno suppression	Ulcerating anal or perianal lesion, Hx of bleeding, HPV infection, receptive anal intercourse, or cancer (especially cervical, vulvar, or vaginal)	Symmetric sharply demarcated erythematous rash, Hx of recurrent anal pruritus and rash, contact sport participation
Investigation		Closed patch test	Antibody serology	Acetowhitening test, anoscopy	Malignancy	Potassium hydroxide wet mount of scales
Management	See Chapter 4	See Chapter 4—Skin Rash: Papules		No cure—manage Sx Self-resolving. Can use cryotherapy, topical creams, or surgical removal. Monitor for HPV-related cancer—anal Pap smear	Oncology referral	Treat cause

history

- Determine the onset, duration, character, localization, relieving and exacerbating factors, and Hx of similar pain
- Determine the medical Hx, with an emphasis on Hx of anorectal disease, infections, rash, receptive anal intercourse, lower GI endoscopy (colonoscopy or sigmoidoscopy), or rectal prolapse

physical Exam

- Perform a complete abdo examination in addition to a perineal and digital rectal exam
- Inspect the perineum for signs of drainage, skin breakdown, and external skin tags
- Palpate the rectum for tenderness, masses (solid or fluctuant), and bleeding
- If the patient is in too much pain to be examined, an exam under anesthesia is sometimes required

Investigations

- No routine blood work is required.
- Colonoscopy or sigmoidoscopy offers an opportunity to visualize and biopsy any lesions contributing to anorectal pain.

Diagnosis

- In most instances, a diagnosis can be made with a careful Hx and physical exam and endoscopic findings.

Management

- Management will depend on the underlying condition
- See Table 8.9 for approach to patient with defecation-associated pain
- See Table 8.10 for approach to patient with perianal rash, erythema, or lesions

CLINICAL box

Management of Hemorrhoids

- Oral fiber intake, stool softeners, or supplements
- Toilet retraining
- Treatment of underlying disease

BREAST LUMP / SCREENING

MCC OBJECTIVE

Based on Objective #10-1 (Breast Lump, Breast Cancer Screening) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Breast lumps are a common cause of presentation to the primary health care provider. While most breast lesions are benign, patients with breast lumps require adequate investigation, follow-up, and reassurance because of the risk of breast cancer.

APPLIED SCIENTIFIC CONCEPT (Figure 8.9)

Breast Anatomy

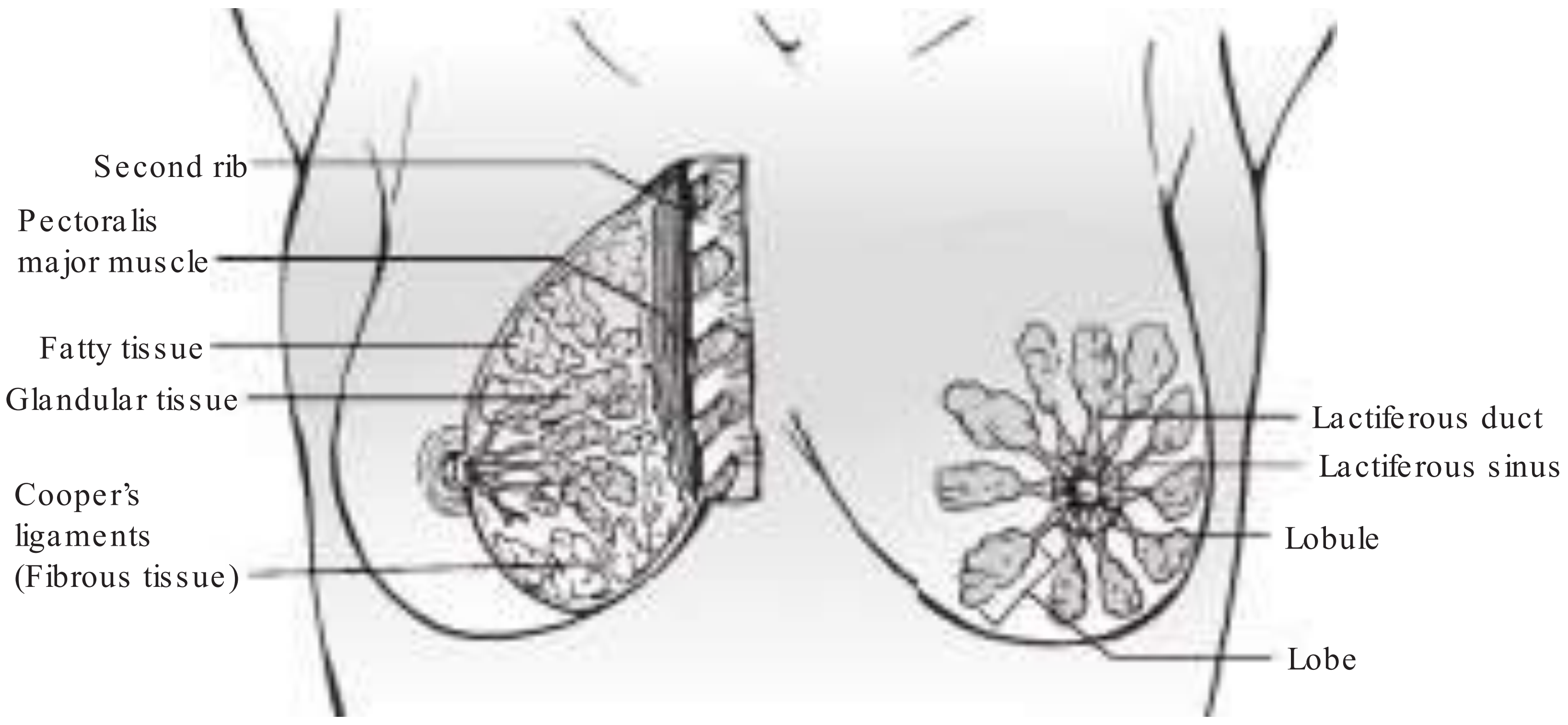


Figure 8.9. Internal anatomy of the breast.

CAUSAL CONDITIONS (Figure 8.10)

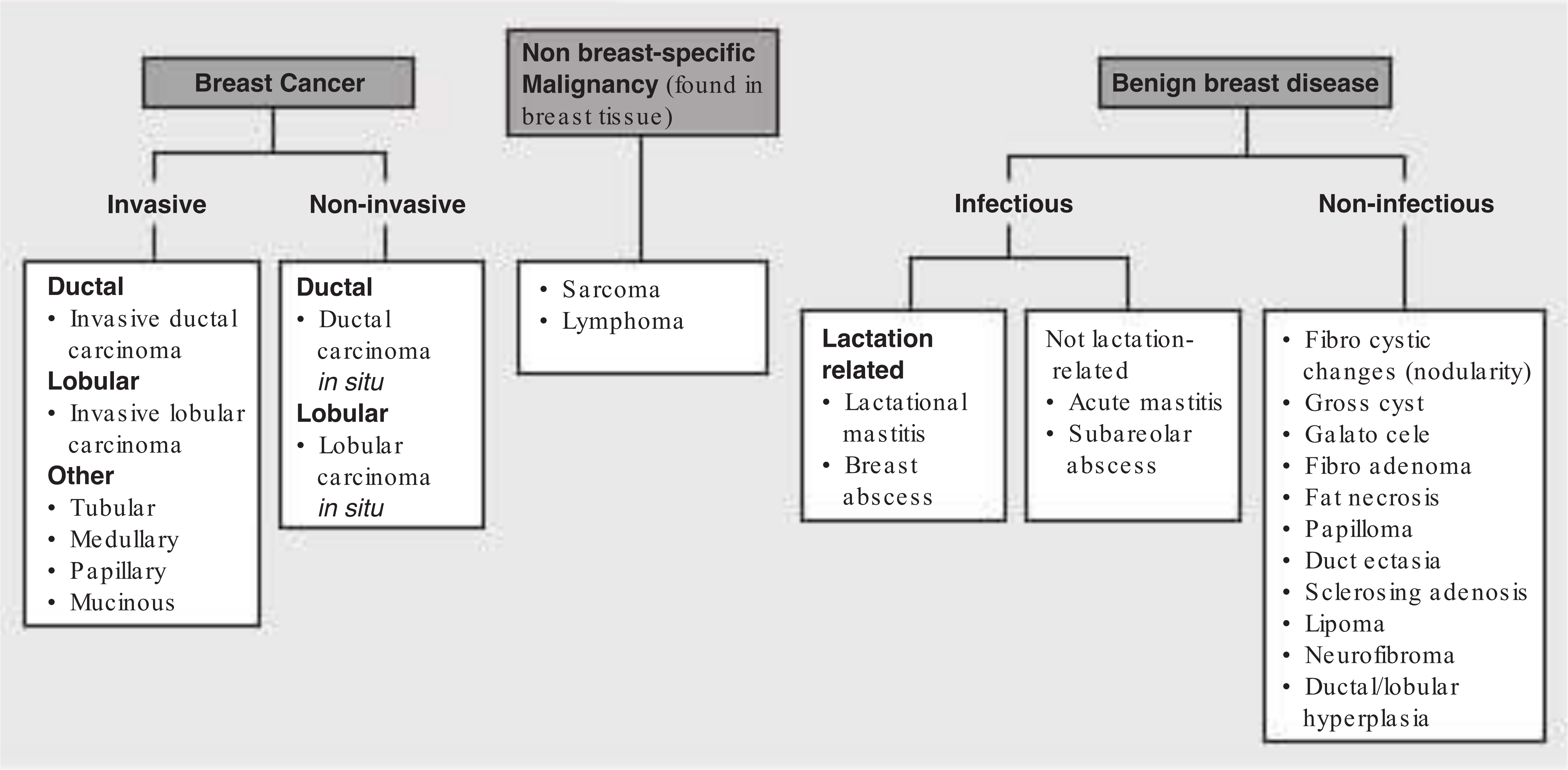


Figure 8.10. Breast lump: causal conditions.

Approach

History (Figure 8.11)

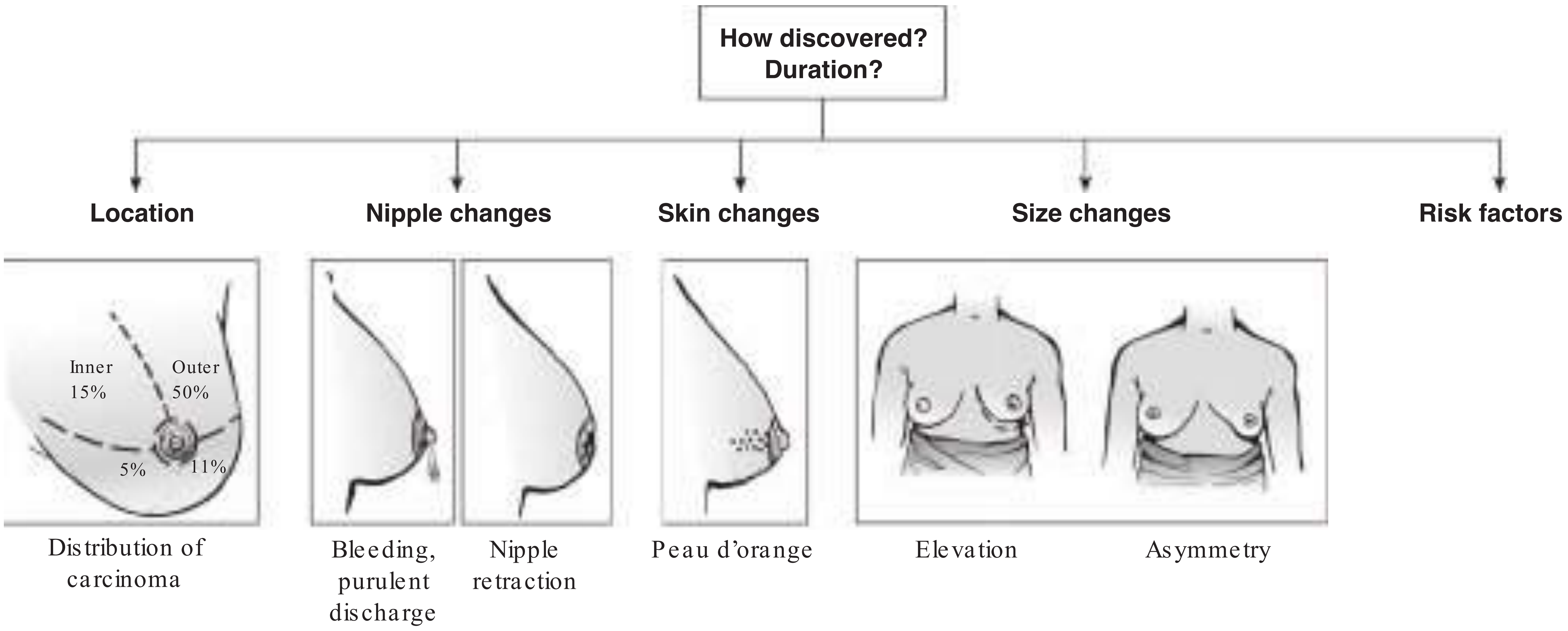


Figure 8.11. Hx of a breast lump.

CLINICAL box

Risk Factors for Breast Cancer

- Age (> 50)
- Female
- Prior Hx of breast or ovarian cancer
- Prior breast biopsy (regardless of pathology)
- Prior radiation therapy at site
- Family Hx of breast or ovarian cancer in 1st/2nd degree relatives
- Hx of prolonged hormone exposure
  - Nulliparity
  - First pregnancy > 30 y.o.
  - Menarche < 12 y.o.
  - Menopause > 55 y.o.
  - HRT > 5 yr
  - Obesity
- Excessive alcohol intake

CLINICAL box

Triple Diagnosis

Refers to diagnosing palpable breast lumps, with concurrent use of:

1. Physical exam
2. Mammography
3. Skilled FNAB

Very few breast cancers are missed using triple diagnosis.

Physical Exam

- See Figure 8.12

Investigations

- See Tables 8.11 and 8.12

Diagnosis

CLINICAL box

Characteristics of Cancerous Lesions

Location	Unilateral
Number	Solitary
Size	> 2 cm[a]
Borders	Irregular
Consistency	Firm/hard
Mobility	Immovable[a]
Change with menses	No change

[a] A lesion that is < 2 cm or movable may still be cancerous.

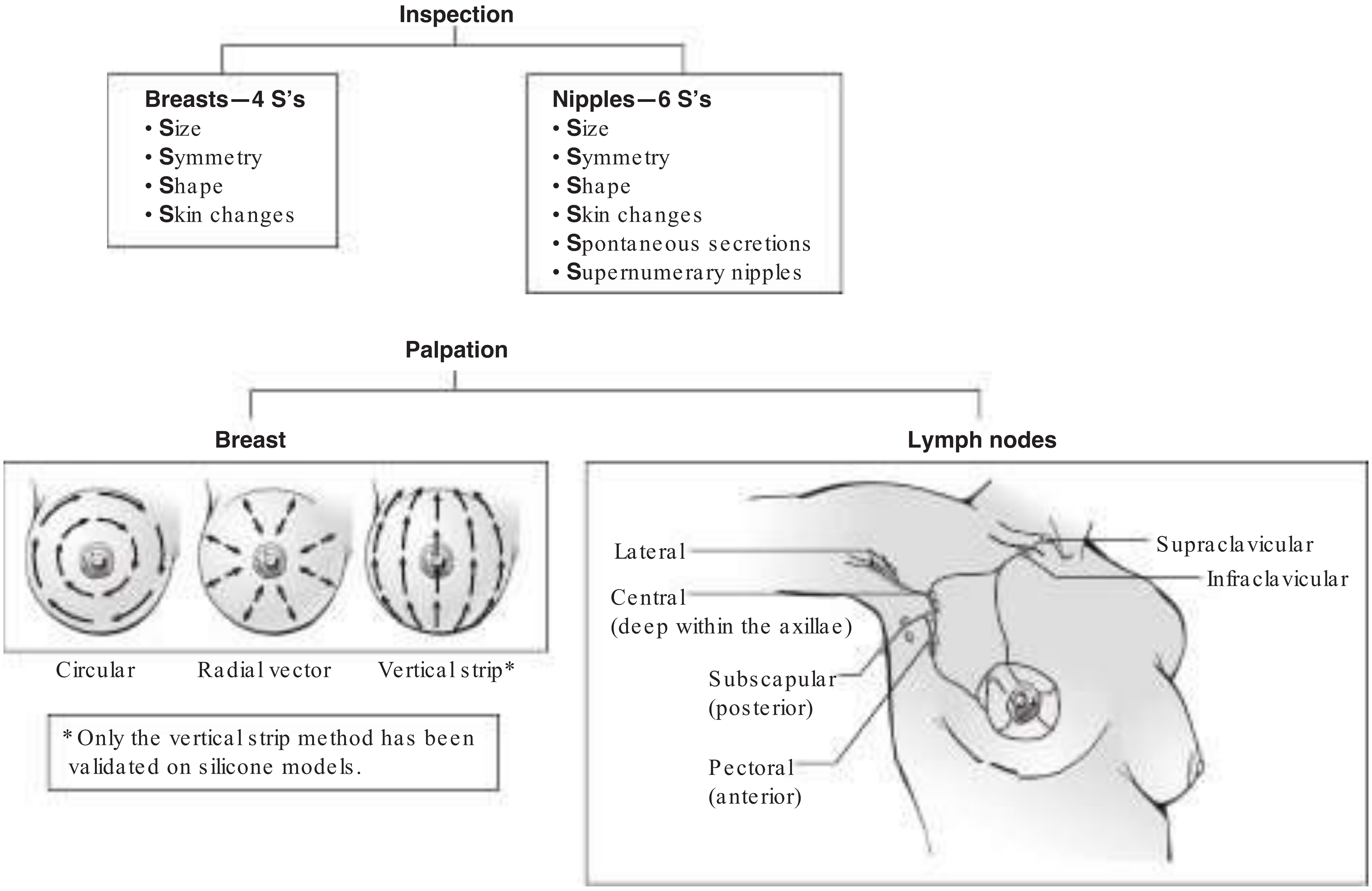


Figure 8.12. Physical exam of breast lump.

TABLE 8.11 • Investigation of breast lump

Modality	Indications	Use	Interpretation
Mammography	Any woman with a new/ concerning breast lump	• Search for other lesions that are clinically occult • Evaluate lump	Features suggesting malignancy • Increased density • Irregular margins • Spiculation • Accompanying clustered irregular microcalcifications
U/S	Any woman with a new/ concerning breast lump	Differentiate between simple or complex cystic or solid lumps	• Risk for cancer is low if lesion is a simple cyst • Complex cystic or solid lumps require further investigation
FNAB	Complex cyst or solid lump found on U/S	Collect samples for cytology	• Fluid obtained without blood unlikely to be cancer • If fluid is bloody, send for cytology • If no fluid, aspirate cells for cytology
Core needle biopsy	Atypical or suspicious FNAB	• Collect samples for histology • Allows staining for ER, PR, and HER2/neu where indicated	Can differentiate between atypical hyperplasia and ductal carcinoma in situ from invasive disease
MRI[a]	Any women for whom mammogram and U/S results are inconclusive	• Detection of breast lump • Further characterization of mass detected on screening for breast cancer	Features suggesting malignancy • Increased density • Irregular margins • Spiculation • Rim pattern of enhancement • Washout of signal intensity

[a] Limited availability for evaluation of breast lump in some areas.

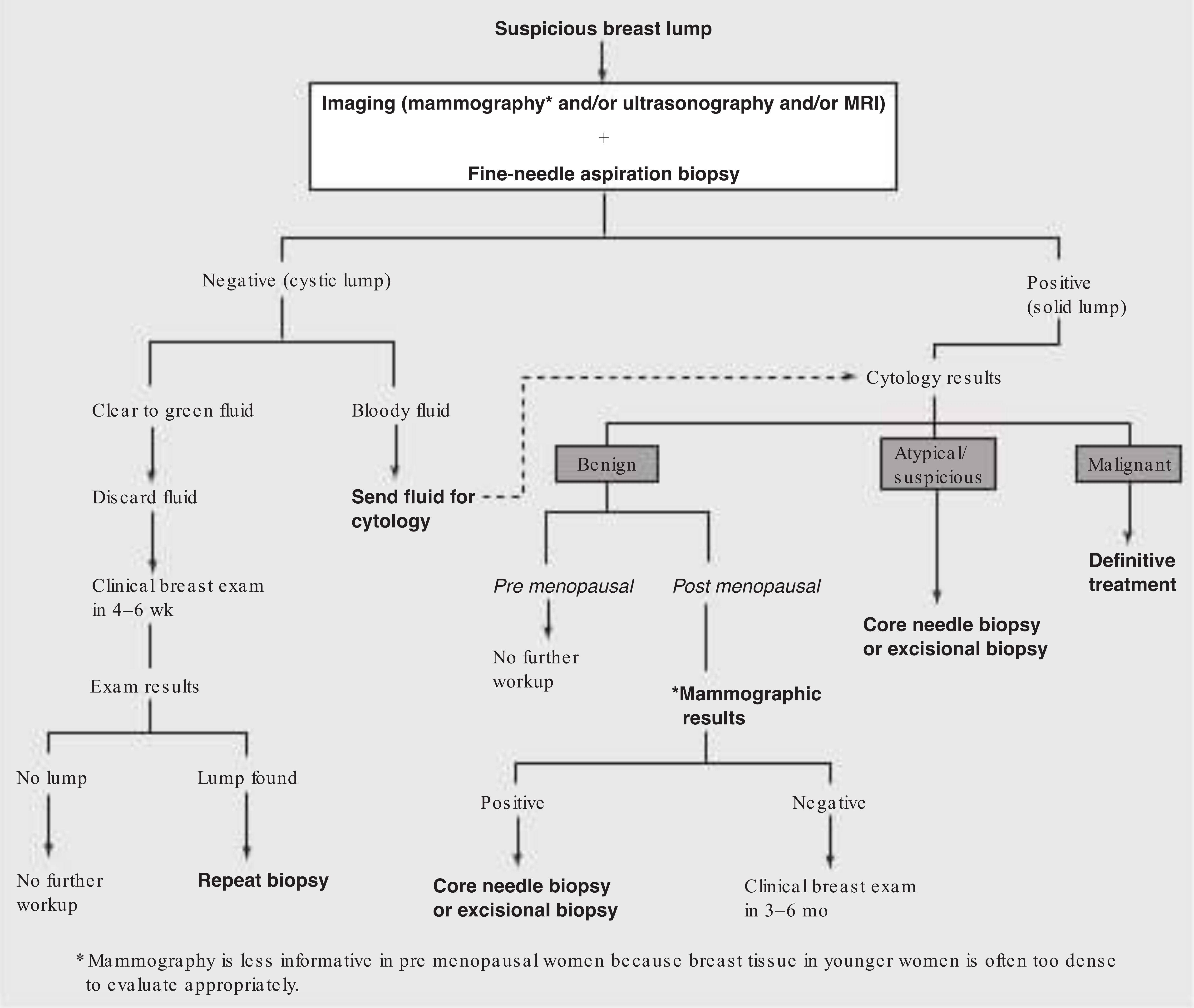
TABLE 8.12 • Breast cancer screening

Mammography (± Clinical Exam)	Breast Self-Exam	Genetic Testing for Breast Cancer 1 or 2 Gene[a]
40–49 y.o. • No evidence to include or exclude screening exam as it has not been consistently shown to reduce mortality	• No clear evidence of benefit in reduction of breast cancer mortality	**Ashkenazi Jewish women** • Any 1st degree relative **or** two 2nd degree relatives from the same side of the family with breast cancer or ovarian cancer

50–69 y.o.
• Every 1–2 yr
Positive family Hx in 1st degree relative
• Every 1–2 yr starting 10 yr before youngest age of presentation
		All other women
		• Patient age < 35 at diagnosis of breast cancer
		• Patient or 1st degree relative with both breast cancer and ovarian cancer regardless of age at diagnosis
		• Patient or 1st degree relative with bilateral breast cancer
		• Patient with strong family Hx of breast cancer and/or ovarian cancer
		  ◦ Two 1st degree relatives, one age < 50 at diagnosis **or** three 1st degree relatives regardless of age at diagnosis
		  ◦ Combination of two or more 1st or 2nd degree relatives with ovarian cancer regardless of age at diagnosis
		• Hx of breast cancer in male relative

[a] Guidelines from U.S. Preventive Services Task Force. Genetic risk assessment and BRCA mutation testing for breast and ovarian cancer susceptibility: recommendation statement. Ann Intern Med. 2005;143(5):355–361.

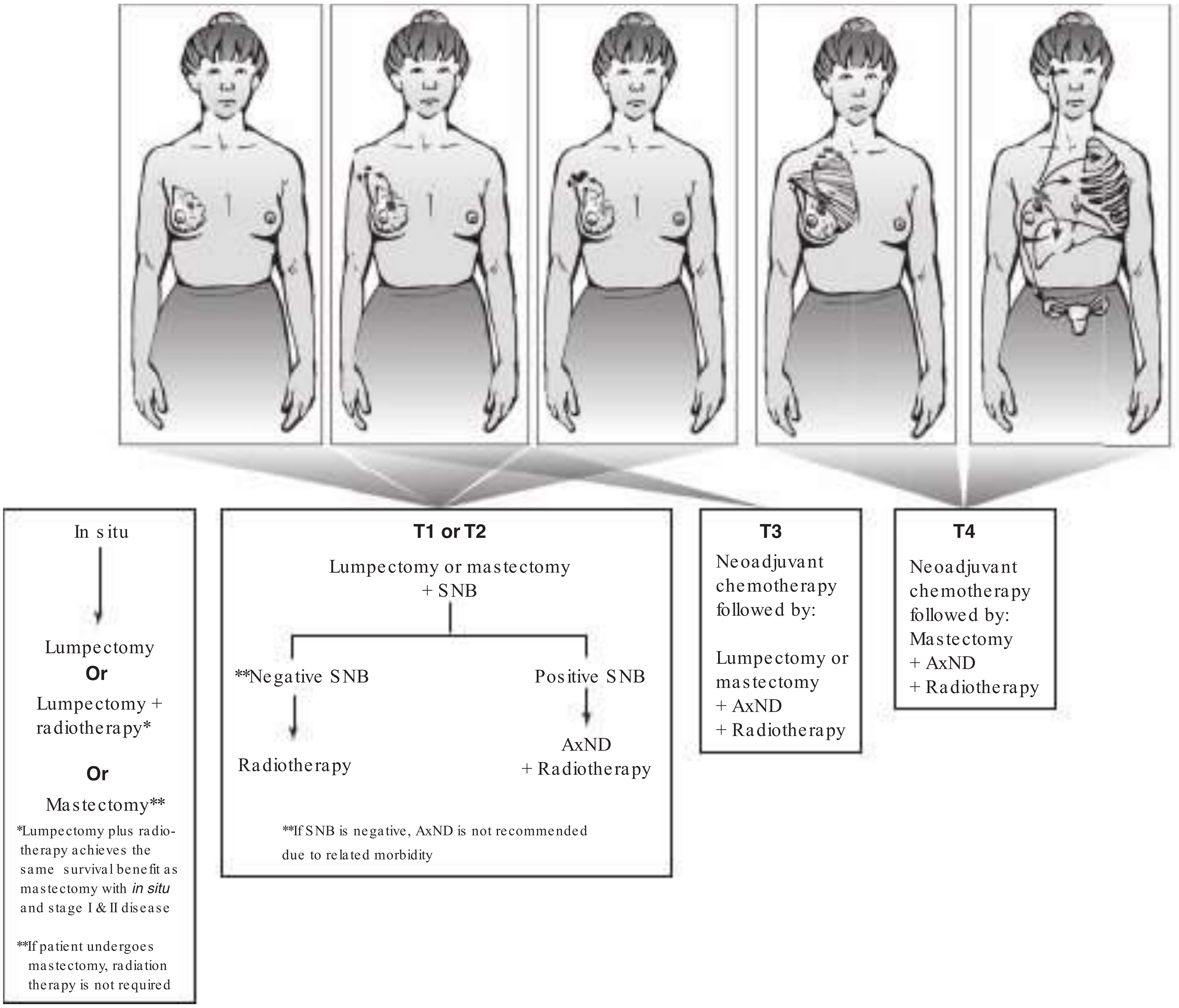
Management (Figures 8.13 and 8.14 and Table 8.13)



* Mammography is less informative in pre menopausal women because breast tissue in younger women is often too dense to evaluate appropriately.

Figure 8.13. Clinical decision making of breast lump.

Stage	0	IA	IB	IIA	IIB	IIIA	IIIB	IIIC	IV
Tumor	Tis	T1	T0 T1	T0 T1 T2	T2 T3	T0 T1 T2 T3 T3	T4 T4 T4	Any T	Any T
Node	N0	N0	N1 mi N1 mi	N1 N1 N0	N1 N0	N2 N2 N2 N1 N2	N0 N1 N2	N3	Any N
Metastasis	M0	M0	M0 M0	M0 M0 M0	M0 M0	M0 M0 M0 M0 M0	M0 M0 M0	M0	M1



In situ

Lumpectomy
Or
Lumpectomy + radiotherapy*
Or
Mastectomy**

*Lumpectomy plus radiotherapy achieves the same survival benefit as mastectomy with *in situ* and stage I & II disease

**If patient undergoes mastectomy, radiation therapy is not required

T1 or T2

Lumpectomy or mastectomy + SNB

**Negative SNB → Radiotherapy

Positive SNB → AxND + Radiotherapy

**If SNB is negative, AxND is not recommended due to related morbidity

T3

Neoadjuvant chemotherapy followed by:

Lumpectomy or mastectomy
+ AxND
+ Radiotherapy

T4

Neoadjuvant chemotherapy followed by:
Mastectomy
+ AxND
+ Radiotherapy

Figure 8.14. Breast cancer staging and management (Edge SB, Byrd DR, Compton CC, et al., eds. *AJCC Cancer Staging Manual*. 7th ed. New York, NY: Springer; 2010:347–376).

CLINICAL box

Staging

Breast cancer staging requires removal of the primary tumor and ipsilateral axillary lymph node dissection.

- If tumors are > 5 cm and axillary lymph nodes are positive, additional staging tests (chest x-ray, bone scan, CT Abdo) are required.
- Smaller tumors with negative axillary lymph nodes do not mandate additional staging tests unless symptoms of metastatic involvement are present.

TABLE 8.13 • Indications for adjuvant therapy

Radiotherapy	hormonal	Chemotherapy
• After lumpectomy • After mastectomy in stage IIIB disease • With axillary node involvement	• Almost all patients with tumor size > 1 cm, ER/PR positive following surgery • Premenopausal: tamoxifen, or ovarian ablation, or ovarian ablation and aromatase inhibitor (anastrozole, letrozole) • Postmenopausal: tamoxifen, or aromatase inhibitor	• Depends on tumor size, number of involved lymph nodes, and patient performance status • Most patients with stage II or III disease • Stage I disease with HER2/neu positive tumor • Trastuzumab (Herceptin) should be used in all HER2/neu overexpressing tumors

See Table 8.14 for oncologic emergencies not specific to breast cancer.

TABLE 8.14 • Oncologic emergencies (not specific to breast cancer)

Oncologic Emergency	Description
Metabolic	
Tumor lysis syndrome	• Triad of hyperuricemia, hyperkalemia, hyperphosphatemia • Results from rapid release of intracellular contents of tumor cells into bloodstream • Hyperkalemia is the most life-threatening problem
Hypercalcemia of malignancy	• Disorder of calcium metabolism due to alterations in the pathways of calcium regulation involving PTH, calcitonin, and (1,25[OH]$_2$ vitamin D) • Patients are invariably dehydrated
Neurologic	
Strokes and seizures	• Both hemorrhagic and thrombotic subtypes of strokes • Occur in both patients with and those without cerebral metastases
Mechanical	
SVC syndrome	• Cough; dyspnea; dysphagia; swelling and discoloration of the neck, face, or upper extremities; and possibly vocal cord paralysis and Horner syndrome • Results from an increase in central venous pressure caused by vena caval obstruction
Spinal cord compression	• Sx include pain, weakness, sensory deficits, autonomic dysfunction • Results from spinal cord being compressed by tumor • Not immediately life threatening unless involving level C3 or above, but may lead to profound, permanent morbidity
Treatment-Related	
Extravasation of chemotherapeutic drugs	• Leakage of chemotherapeutic drugs into the skin, leading to pain, redness, swelling, and possibly necrosis • Typically results from infusion therapy
Neutropenic fever	• Neutrophil count < 0.5 × 10(9)/L (500/mm^3), or < 1.0 × 10(9)/L and expected to decline below < 0.5 soon • Fever defined as single temperature of 38.3°C (101.0°F) or a temperature of 38.0°C (100.4°F) or higher lasting over 1 h
Hematology	
DIC of malignancy	• Hx of malignancy • Clinical presentation of bleeding, thromboembolism, liver dysfunction, kidney failure, respiratory distress, or change in CNS exam • Thrombocytopenia • MAHA (microangiopathic hemolytic anemia) on blood smear

CHEST INJURIES

MCC OBJECTIVE

Based on Objective #109-4 (Chest Injuries) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Chest trauma is classified as blunt or penetrating, and requires prompt medical attention to prevent life-threatening complications secondary to cardiac, thoracic, or musculoskeletal injury.

CAUSAL CONDITIONS

- Blunt chest trauma
  - Blast injuries
  - Deceleration injury (e.g., motor vehicle accidents and falls)
- Penetrating chest trauma
  - Gunshot wound
  - Stab wound

APPROACH

History

- It is important to establish the mechanism of injury (Table 8.15) and the prehospital treatment received (e.g., amount of fluids received, intravenous lines established) as well as the patient's medical Hx.
- Obtain a Hx of pain associated with thoracic trauma. Delayed onset of pain suggests a flail chest.

TABLE 8.15 • Common injuries associated with thoracic trauma

Lungs	Tracheobronchial tree injury Pulmonary contusion Hemothorax Pneumothorax (open, closed, tension)
MSK	Clavicle; sternum; rib fracture Flail chest
Esophagus	Esophageal rupture
Great vessel	Aortic rupture Aortic dissection
Heart	Pericardial trauma (pericarditis, acute/delayed tamponade) Myocardial trauma (contusion, coronary vessel injury)
Diaphragm	Diaphragmatic injury

Physical Exam

- Every trauma patient should undergo a **primary survey** using the ABCDE algorithm followed by a secondary survey:
  - Airway: if the patient is alert and conversant, then the airway is likely secured. Patients with significant facial bone trauma, upper airway burns, or deteriorating mental status (Glasgow Coma Scale ≤8) require intubation. Current trauma algorithms also include C-spine management along with airway. C-spine protection should be in place with a collar or immobilizing device present.
  - Breathing: inspect the patient's trachea and chest for signs of tension pneumothorax, flail chest, or open pneumothorax and manage immediately.
  - Circulation: assess for signs of hemorrhagic or cardiogenic shock. Assess vitals in a monitored setting.
  - Disability: perform a neurologic exam and assess the patient's level of consciousness and any focal neurologic signs. It is important to document and follow serial GCS assessments.

  - Exposure: remove patient's clothing and carefully inspect for missed injuries. Patient is typically logrolled in appropriate spinal precautions and assessed for spinal tenderness/asymmetry/malalignment in addition to a DRE exam. Prevent rapid heat loss with warming blankets and warmed intravenous resuscitation fluids.
- For classification of hemorrhage and associated physiologic changes, see Table 8.16.

Table 8.16 • Classification of hemorrhage and associated physiologic Ds

	Class I	Class II	Class III	Class IV
Blood loss (% of TBV)	< 15%	15%–30%	30%–40%	> 40%
HR	< 100	> 100	> 120	> 140
BP	Normal	Normal	↓	↓↓
Pulse pressure	Normal	↓	↓↓	↓↓↓
RR	Normal	20–30	30–40	> 35
U/O (mL/h)	> 30	20–30	5–15	Scant
Mental status	Slightly anxious	Mildly anxious	Anxious, confused	Confused, lethargic

Adapted from the American College of Surgeons ATLS Guidelines.

- For clinical presentation of obstructive versus hypovolemic shock, see Table 8.17.

Table 8.17 • Clinical presentation of obstructive versus hypovolemic shock

Signs and Sx	Obstructive (e.g., Cardiac Tamponade)	Hypovolemic
Breath sounds	Normal	↓ (On affected side)
Heart sounds	Muffled	Normal
BP	↓	↓
JVP	Elevated	↓ or flat

Investigations

- The patient's vital signs should be monitored continuously.
- Routine blood work: in addition to a complete blood count, electrolytes, and coagulation profile, the patient should be cross-matched for several units of packed red blood cells. An arterial blood gas panel should also be obtained to assess for adequacy of the patient's respiratory function.
- Every female patient within childbearing age should have a b-hCG test to exclude pregnancy.
- A portable chest x-ray should be promptly arranged to assess for pneumothorax, hemothorax, or mediastinal widening.
- Depending on the mechanism of injury and pretest index of suspicion, the hemodynamically stable patient should undergo a CT scan of the head, neck, spine, chest, abdomen, pelvis, or extremities to exclude occult injury and prioritize the management approach.

Management (Figure 8.15)

- Following the ATLS protocol has been shown to improve outcomes for trauma patients by standardizing the approach to management and prioritizing the patient's urgent needs.
- Pain control is vital in patients with thoracic injuries to maintain adequate Resp effort and bronchial toileting and prevent pneumonia and atelectasis. Incentive spirometry, chest physiotherapy, and early involvement of the hospital's pain service should be considered.

CLINICAL box

Beck Triad: Cardiac Tamponade

1. Elevated JVP
2. ↓ BP
3. Muffled heart sounds

CLINICAL box

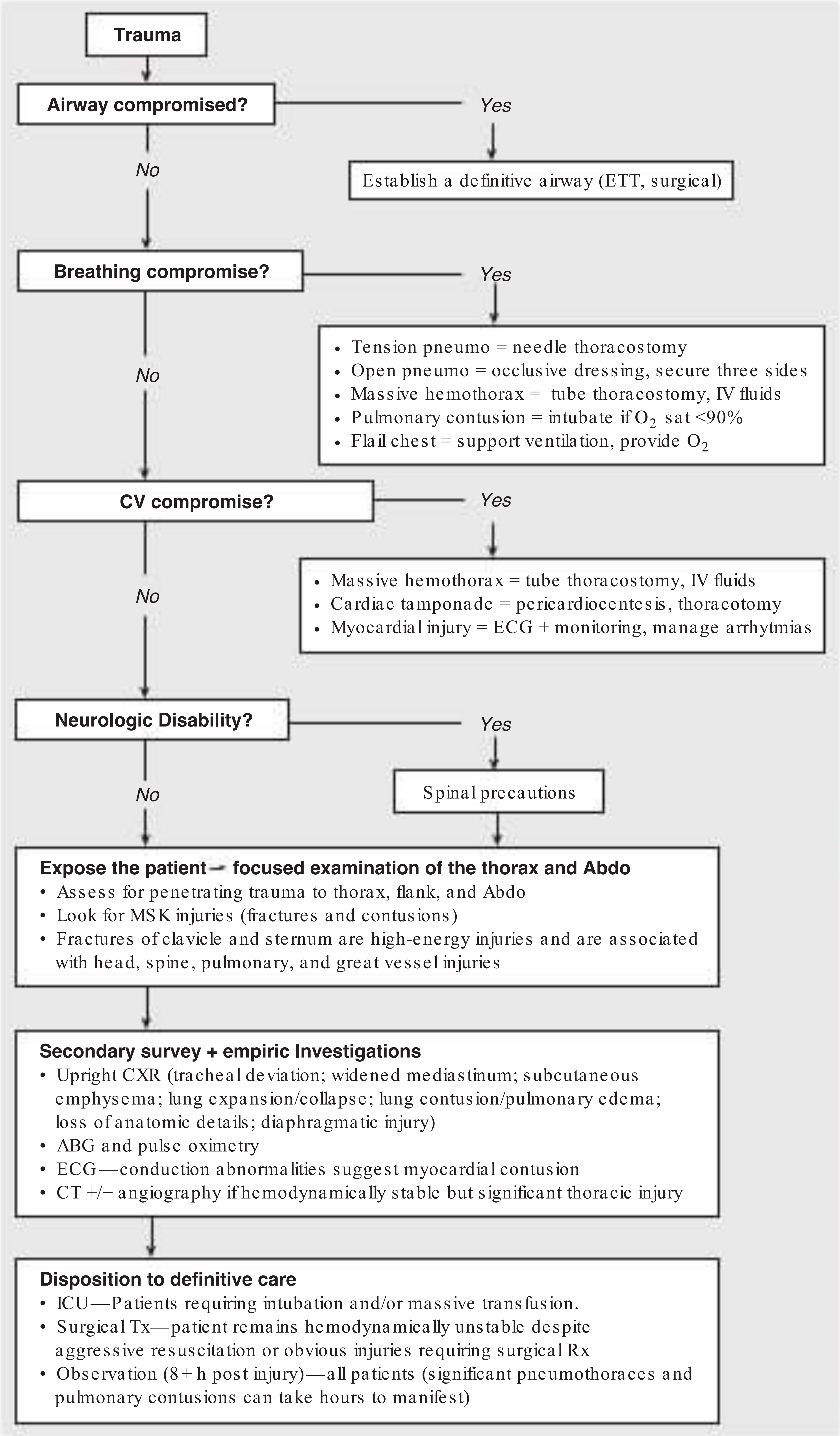
Presentation of Acute Aortic Rupture

- Chest or midscapular pain
- Dyspnea
- Hoarseness
- Dysphagia may be asymptomatic.

CLINICAL box

CXR Signs of Aortic Disruption

- Widened mediastinum (> 8 cm)
- Indistinct aortic knob
- Depressed left main bronchus
- Tracheal deviation (right)
- NG tube deviation
- Widened right paratracheal stripe (> 5 mm)
- Apical capping
- Loss of space between the pulmonary artery and aorta



Establish a definitive airway (ETT, surgical)

- Tension pneumo = needle thoracostomy
- Open pneumo = occlusive dressing, secure three sides
- Massive hemothorax = tube thoracostomy, IV fluids
- Pulmonary contusion = intubate if O_2 sat <90%
- Flail chest = support ventilation, provide O_2

- Massive hemothorax = tube thoracostomy, IV fluids
- Cardiac tamponade = pericardiocentesis, thoracotomy
- Myocardial injury = ECG + monitoring, manage arrhytmias

Expose the patient – focused examination of the thorax and Abdo

- Assess for penetrating trauma to thorax, flank, and Abdo
- Look for MSK injuries (fractures and contusions)
- Fractures of clavicle and sternum are high-energy injuries and are associated with head, spine, pulmonary, and great vessel injuries

Secondary survey + empiric Investigations

- Upright CXR (tracheal deviation; widened mediastinum; subcutaneous emphysema; lung expansion/collapse; lung contusion/pulmonary edema; loss of anatomic details; diaphragmatic injury)
- ABG and pulse oximetry
- ECG—conduction abnormalities suggest myocardial contusion
- CT +/− angiography if hemodynamically stable but significant thoracic injury

Disposition to definitive care

- ICU—Patients requiring intubation and/or massive transfusion.
- Surgical Tx—patient remains hemodynamically unstable despite aggressive resuscitation or obvious injuries requiring surgical Rx
- Observation (8+ h post injury)—all patients (significant pneumothoraces and pulmonary contusions can take hours to manifest)

Figure 8.15. Initial Tx of the thoracic trauma patient.

CLINICAL box

Indications for Immediate ED Thoracotomy

Indications

- Acute hemodynamic instability or cardiac arrest in the ED
- Penetrating thoracic injury ± signs of electrical cardiac activity
- Blunt thoracic injury + electrical cardiac activity
- Great vessel injury
- Cardiac tamponade
- Suspected air embolus
- Known esophageal, tracheal, or bronchial injury

Not Indicated If

- Patient with blunt trauma and no sign of electrical cardiac activity
- No qualified surgeon present

ABDOMINAL INJURIES

MCC OBJECTIVE

Based on Objective #109-1 (Abdominal Injuries) of *Objectives for the Qualifying Examination*, 3rd edition.

CLINICAL box

Total Allowable Blood Loss

$$TBV \times \frac{(Hbi - Hbf)}{Hbi}$$

where, Hbi = initial hemoglobin and Hbf = threshold hemoglobin for transfusion

Example: for a 70-kg healthy adult

$$(70)(70) \times \frac{(145 - 80)}{145} = 2.2 \text{ L}$$

Therefore, after approximately 2 L of blood loss, the patient will require PRBC transfusion.

OVERVIEW

Abdo trauma is classified as blunt or penetrating, and requires prompt medical attention to prevent life-threatening complications secondary to hemorrhage and sepsis.

APPLIED SCIENTIFIC CONCEPT (Table 8.18)

TABLE 8.18 • Indications for transfusion of PRBCs in trauma

Absolute	Relative
Hb < 80 g/L in any patient	• Hb < 100 g/L in a patient with known CV disease • Suspected or known massive hemorrhage • Persistent hypotension following 2 L of IV crystalloids • Evidence of end-organ dysfunction 2° to hypoxia

CAUSAL CONDITIONS

- In blunt abdo trauma, compressive forces disrupt tissues and rupture hollow viscera.
- Any penetrating trauma to the lower chest, flank, back, or pelvis should also be suspected of causing abdo injury until proven otherwise.
- Rapid decelerations can cause relatively mobile organs to move abruptly about their tethers (e.g., the small bowel at the ligament of Treitz and bowel surrounding the ileocecal junction), resulting in injury (Table 8.19).

TABLE 8.19 • Common mechanisms and associated abdo injuries

	Mechanism of Injury	Commonly Injured Organs
Penetrating trauma	Stab wounds; missile/gunshot wounds	Spleen, liver, pancreas, duodenum, small intestine, colon
Blunt trauma	Motor vehicle/bicycle/all-terrain vehicle crash; auto vs. pedestrian injury; fall from height; child abuse	Spleen, liver, GU tract, pelvis

APPROACH

History

- It is important to establish the mechanism of injury and the prehospital treatment received (e.g., amount of fluids received, intravenous lines established) as well as the patient's medical Hx.
- Injuries to the abdo viscera often produce nonspecific signs and symptoms, many of which take hours to days to develop.

Physical Exam

- Every trauma patient should undergo a **primary survey** using the ABCDE algorithm followed by a secondary survey:
  - Airway: if the patient is alert and conversant, then the airway is likely secured. Patients with significant facial bone trauma, upper airway burns, or deteriorating mental status (Glasgow Coma Scale ≤8) require intubation.
  - Breathing: inspect the patient's trachea and chest for signs of tension pneumothorax, flail chest, or open pneumothorax and manage immediately.
  - Circulation: Assess for signs of hemorrhagic or cardiogenic shock. In the setting of hypotension and a positive FAST, urgent laparotomy is indicated.
  - Disability: perform a neurologic examination and assess the patient's level of consciousness and any focal neurologic signs.
  - Exposure: remove patient's clothing and carefully inspect for missed injuries. It is crucial to assess for blood on DRE as well as presence of tone. Prevent

rapid heat loss with warming blankets and warmed intravenous resuscitation fluids.
- A tense and distended abdomen suggests increased intra-abdo pressure and may indicate a developing abdo compartment syndrome.

Investigations (Table 8.20)

TABLE 8.20 • Diagnostic investigations in the evaluation of abdo trauma

	Px	FAST	DPL	CT	Exploratory Laparotomy
Rapid	Yes	Yes	Yes	No	No
Sensitive	No	Yes	Yes	Yes	Yes
Specific	No	No	No	Yes	Yes
Repeatable	Yes	Yes	Yes	Yes	Yes
Invasive	No	No	Yes	No	Yes

CLINICAL box

fAST

Assesses for free fluid in four areas—the four "Ps": Perisplenic, Perihepatic, Pelvic, and Pericardial

CLINICAL box

values for positive DpL

Gunshot = 5,000 RBC/mL
Blunt = 100,000 RBC/mL
Stabbing = 10,000 RBC/mL

- The patient's vital signs should be monitored continuously.
- Routine blood work: in addition to a complete blood count, electrolytes, and coagulation profile, the patient should be cross-matched for several units of packed red blood cells. An arterial blood gas panel should also be obtained to assess for adequacy of the patient's Resp function.
- Every female patient within childbearing age should have a b-hCG test to exclude pregnancy.
- Urinalysis should be obtained to rule out occult bleeding suggestive of kidney trauma.
- A FAST U/S study should be promptly obtained to assess the patient's peritoneal cavity for free fluid.
- DPL may be considered in select patients. It involves infusion and drainage of 1 L of saline into the abdomen, aspirating the fluid, and analyzing it for the number of red blood cells present. Like FAST, DPL does not localize the injury and cannot identify a retroperitoneal source of bleeding. Few, if any, level one trauma centers in Canada still use DPL. Decisions regarding operative versus nonoperative management are made based on clinical picture, FAST status, and CT findings.
- Depending on the mechanism of injury and pretest index of suspicion, the hemodynamically stable patient should undergo a CT scan of the head, neck, spine, chest, abdomen, pelvis, or extremities to exclude occult injury and prioritize the management approach.

Management (Figure 8.16)

- Indications for urgent laparotomy in abdo trauma:
  - Hemodynamically unstable patient with Abdo, back, or flank trauma
  - Obvious evisceration
  - Physical exam findings consistent with peritonitis
  - Transabdominal gunshot wound
  - Penetrating wound that extends through the fascia
  - Free air present on either x-ray or CT
  - Abdo organ injury as seen on CT that requires surgical repair.
- Hemodynamically stable patients with a positive DPL, FAST, or CT scan but no indications for emergent laparotomy are candidates for a trial of nonoperative therapy with close monitoring and serial blood work and abdo exams.
- Most patients with blunt hepatic and splenic injuries are given a trial of nonoperative management.
- Patients with ongoing bleeding, particularly from a splenic injury, may require angiography with possible embolization. Other locations may include the liver or injured pelvic vessels.

CLINICAL box

Causes of Hypotension in the abdo Trauma patient

- Acute blood loss/hemorrhagic shock
- Spinal shock
- Toxic ingestion
- Pregnancy
- Acute and chronic Resp or cardiac disease

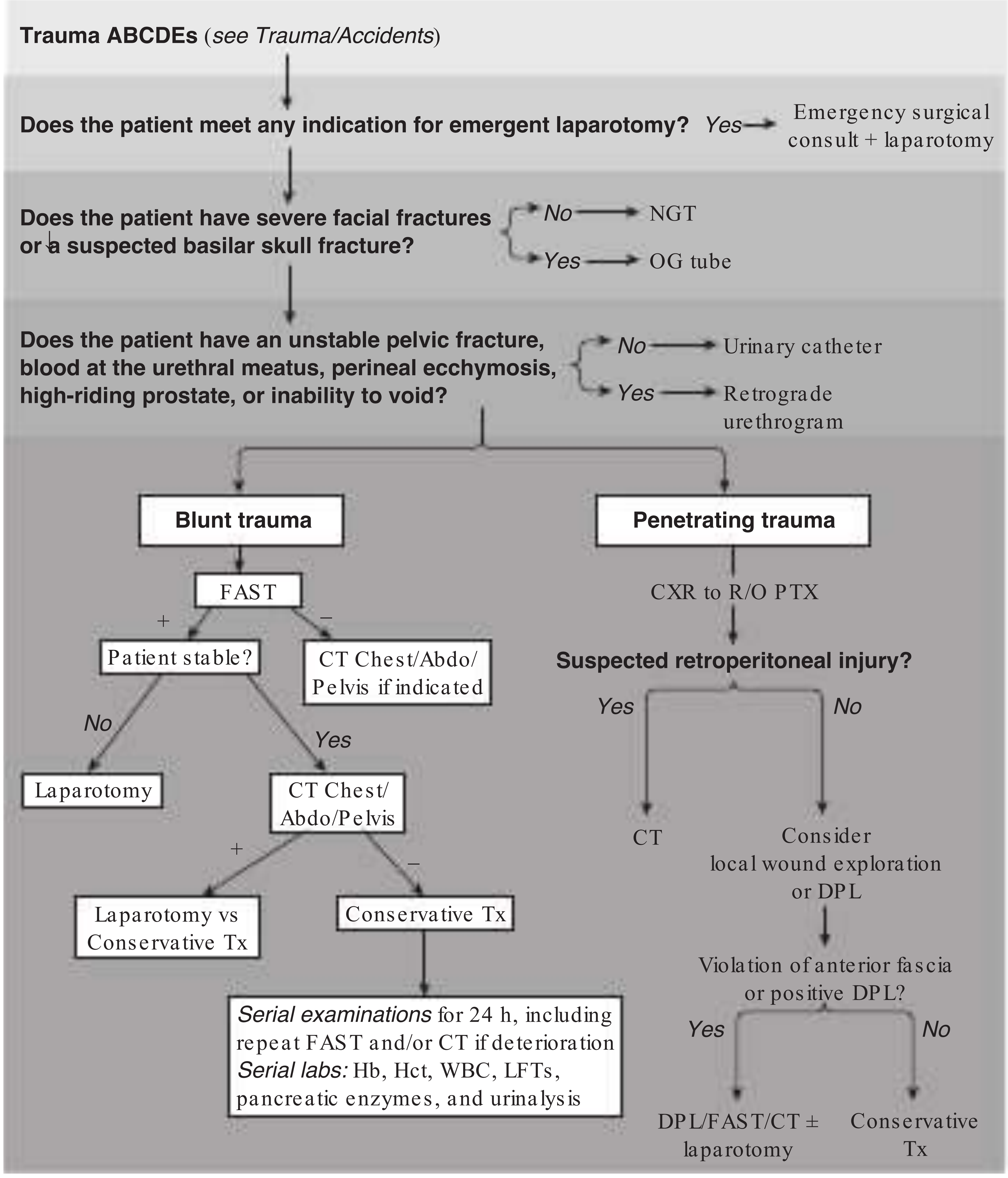

Trauma ABCDEs (see Trauma/Accidents)
Does the patient meet any indication for emergent laparotomy?
Yes
Emergency surgical consult + laparotomy
Does the patient have severe facial fractures or a suspected basilar skull fracture?
No
NGT
Yes
OG tube
Does the patient have an unstable pelvic fracture, blood at the urethral meatus, perineal ecchymosis, high-riding prostate, or inability to void?
No
Urinary catheter
Yes
Retrograde urethrogram
Blunt trauma
FAST
+
−
Patient stable?
CT Chest/Abdo/Pelvis if indicated
No
Laparotomy
Yes
CT Chest/Abdo/Pelvis
+
Laparotomy vs Conservative Tx
−
Conservative Tx
Serial examinations for 24 h, including repeat FAST and/or CT if deterioration
Serial labs: Hb, Hct, WBC, LFTs, pancreatic enzymes, and urinalysis
Penetrating trauma
CXR to R/O PTX
Suspected retroperitoneal injury?
Yes
CT
No
Consider local wound exploration or DPL
Violation of anterior fascia or positive DPL?
Yes
DPL/FAST/CT ± laparotomy
No
Conservative Tx

Figure 8.16. Initial Tx of the abdo trauma patient.

VASCULAR INJURIES

MCC OBJECTIVE

Based on Objective #109-15 (Vascular Injury) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Vascular injuries are classified as blunt and penetrating, can occur anywhere in the body, and may be limb- or life-threatening if not identified and managed promptly. Most patients with major vessel trauma die before arrival to hospital.

CAUSAL CONDITIONS

Blunt Trauma

- Contusion
- Acceleration/deceleration injury

Penetrating Trauma

- Stab wound
- Gunshot wound

Compartment Syndrome

- Crush or long bone injury
- Unrecognized/uncontrolled bleeding
- Ischemic reperfusion injury
- Burns
- Binding casts/dressings

Appr OACh

history and physical Exam (Table 8.21)

TABLE 8.21 • Occlusive versus hemorrhagic arterial injuries

	Occlusive Injury	Hemorrhagic Injury
Hx	• Penetrating wound within 1 cm of a neurovascular bundle • Obvious arterial transection • Peripheral neuropathy • Hx of stasis, previous limb trauma, intermittent claudication, or other RF for arterial thrombosis or embolism	Orthopedic injuries, particularly knee dislocation and fractures
	PHYSICAL EXAM	
Vitals	Normal, unless other concomitant injuries or arterial transaction	Hemodynamically unstable
Hematoma	May be present	Present, pulsatile if arterial source
Pulse deficit	Present, quantify with an API	May be present if arterial transection
Distal ischemia	Present if lesion is fully occlusive	May be present if arterial compromise

- Compartment syndrome: pain out of proportion to physical exam, pain on passive stretch or active flexion of the compartment, parasthesia in the distal peripheral nerves that cross the compartment. Compartment pressure > 30 mm Hg of patient's DBP leading to vascular occlusion and tissue ischemia.
- API: ratio of SBP distal to arterial injury site to SBP measured in contralateral uninjured limb, normally ≥ 0.9, not to be confused with ABI.

Investigations

- API, ABI, and CTA and U/S as clinically indicated

Diagnosis

- Vascular injuries may be subclinical on initial assessment. High-risk patients require serial exams.
- Arterial injuries can be occlusive or hemorrhagic.
- Injuries that involve arterial transection have both occlusive and hemorrhagic features.
- The two most common vascular injuries are arterial trauma and compartment syndrome.
- Pulsatile bleeding/hematoma or any of the six Ps of arterial insufficiency carries a > 90% incidence of arterial injury, and 50% have an associated nerve injury.

Management

- It is vital to quickly identify and treat vascular injuries as they carry significant short- and long-term consequences (hemorrhagic shock, distal limb ischemia, thromboembolic events, true and false aneurysms, and fistulae formation) (Figure 8.17).
- Arterial injuries should be initially managed with direct pressure, avoiding tourniquets and the use of clamps.

CLINICAL box

6 ps of Arterial Insufficiency

In order of severity:

Pain
Pallor
Polar (cold)
Pulseless
Paresthesias
Paralysis

CLINICAL box

ApI

$$\frac{\text{SBP injured limb}}{\text{SBP unaffected limb}} = \text{API}$$

- Measure BP distal to injury
- API < 0.90 requires further investigation (angiography).

CLINICAL box

Vascular Injury Dx Test

- CBC, if hemorrhage
- Plain XR (fractures, FB)
- U/S ± duplex
- Handheld Doppler
- API
- Angiography
- Surgical exploration

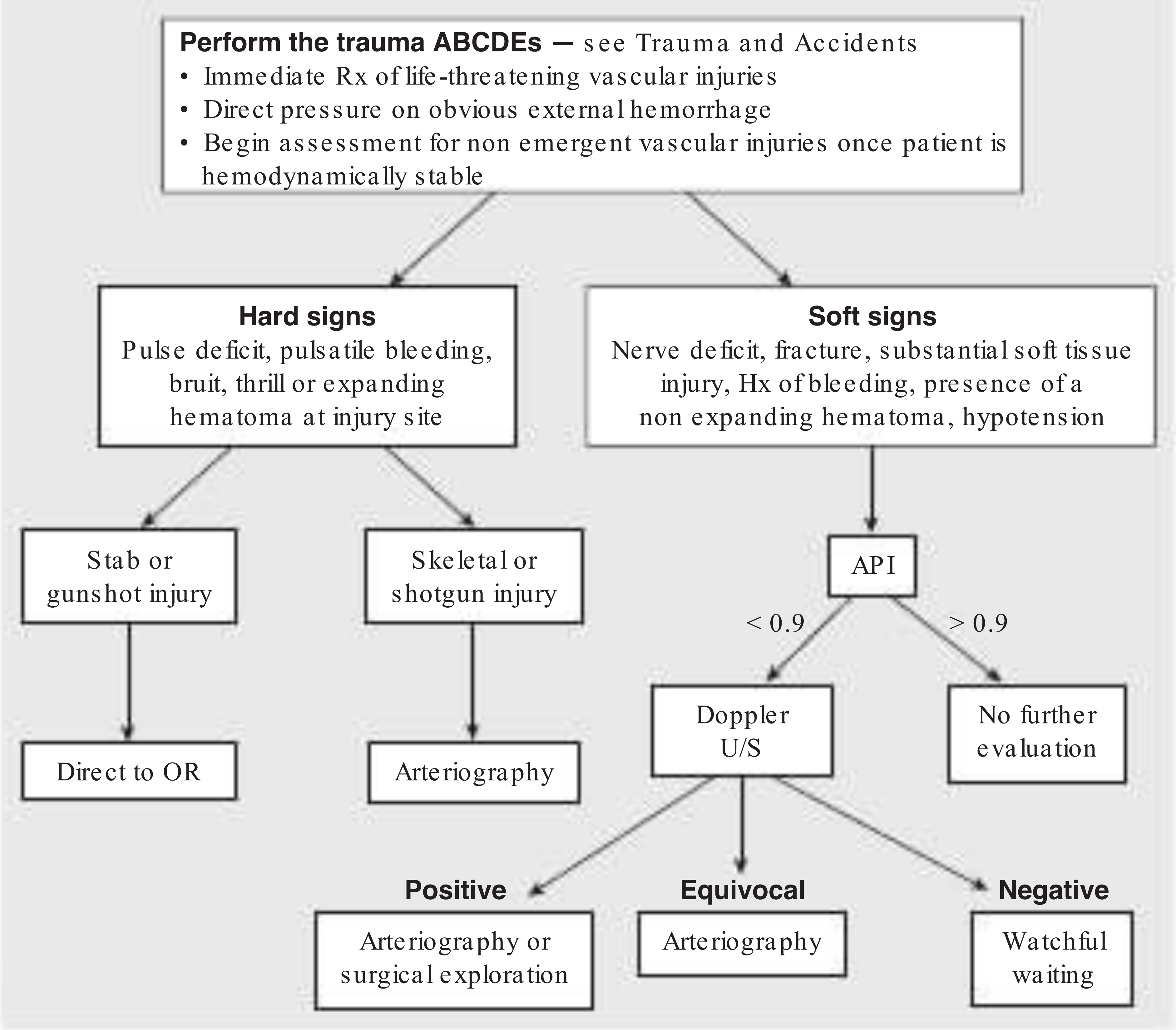

Perform the trauma ABCDEs — see Trauma and Accidents
• Immediate Rx of life-threatening vascular injuries
• Direct pressure on obvious external hemorrhage
• Begin assessment for non emergent vascular injuries once patient is hemodynamically stable
Hard signs
Pulse deficit, pulsatile bleeding, bruit, thrill or expanding hematoma at injury site
Soft signs
Nerve deficit, fracture, substantial soft tissue injury, Hx of bleeding, presence of a non expanding hematoma, hypotension
Stab or gunshot injury
Skeletal or shotgun injury
Direct to OR
Arteriography
API
< 0.9
> 0.9
Doppler U/S
No further evaluation
Positive
Arteriography or surgical exploration
Equivocal
Arteriography
Negative
Watchful waiting

Figure 8.17. Initial assessment for vascular injury.

- Vascular surgery should become involved early in the management of a suspected arterial injury, or patient should be transported to a center with access to a vascular surgeon.

CLINICAL box

Risks of Tourniquets and Clamps

- Vessel clamping can → crushing of nearby nerves
- Tourniquets →↑ compartment pressure; ↑ risk of venous thrombi 2° to stasis

CLINICAL box

Warm Ischemia

Six hours after sustaining a vascular injury, 10% of patients will have irreversible neuromuscular injury. After 12 h, the incidence is 90%.

PREOPERATIVE MEDICAL EVALUATION

MCC OBJECTIVE

Based on Objective #74-3 (Pre-operative Medical Evaluation) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

The objective of preoperative medical evaluation is to optimize patients for surgery and identify any undiagnosed pathology. It is an interdisciplinary effort involving surgeons, anesthetists, family doctors, and medical specialists, but can sometimes be limited or omitted in the unstable patient.

APPROACH

History

- A careful Hx is needed to identify cardiovascular, cerebrovascular, pulmonary, renal, or endocrine disease. Prior surgeries should also be noted along with tobacco, alcohol, and drug consumption.
- Personal or familial Hx of adverse reaction to anesthetic should be noted.
- All prescribed and over-the-counter medications, including herbal supplements, should be listed.

Physical Exam

- A complete systems-based exam is required to identify signs of disease.
- Signs of cardiovascular, cerebrovascular, or pulmonary compromise should be further investigated with appropriate tests.

Investigations

- CBC: any patient with a Hx of anemia or blood loss or any procedure where > 500 mL blood loss is expected
- Group and screen/type and cross: not needed in low-risk procedures (e.g., breast lumpectomy) where minimal blood loss (< 500 mL) is expected
- Electrolytes, creatinine, and liver function tests: any patient with a Hx of renal or hepatopancreatic disease. Any diabetic patient. Any procedure with a significant amount of blood loss (> 500 mL) or where the use of contrast dye is projected (e.g., angiography).
- Blood sugar: any patient with Hx of diabetes
- Coagulation profile: any patient with a Hx of bleeding or hepatic disease. If patient is on anticoagulation therapy (e.g., patient with a Hx of deep vein thrombosis) and had been instructed to discontinue the therapy, then recheck coagulation profile on morning of surgery
- Urinalysis: any patient with dysuria. All operations with planned prosthesis.
- Pregnancy test: all menstruating female patients
- Chest x-ray: any Hx of cardiovascular or pulmonary disease should have a chest x-ray arranged within 2 wk of surgery, both to assess preoperative function and to provide a reference should the patient's postoperative course deteriorate
- Electrocardiogram: needed for preoperative patients > 50 y.o. and selected patients with known Hx of cardiac disease < 50 y.o.
- Echocardiogram: patients with a Hx of heart failure and patients scheduled to undergo heart or major vessel vascular surgery
- Pulmonary function tests: patients with a Hx of pulmonary disease and any patients scheduled to undergo thoracic surgery

Management (Figure 8.18)

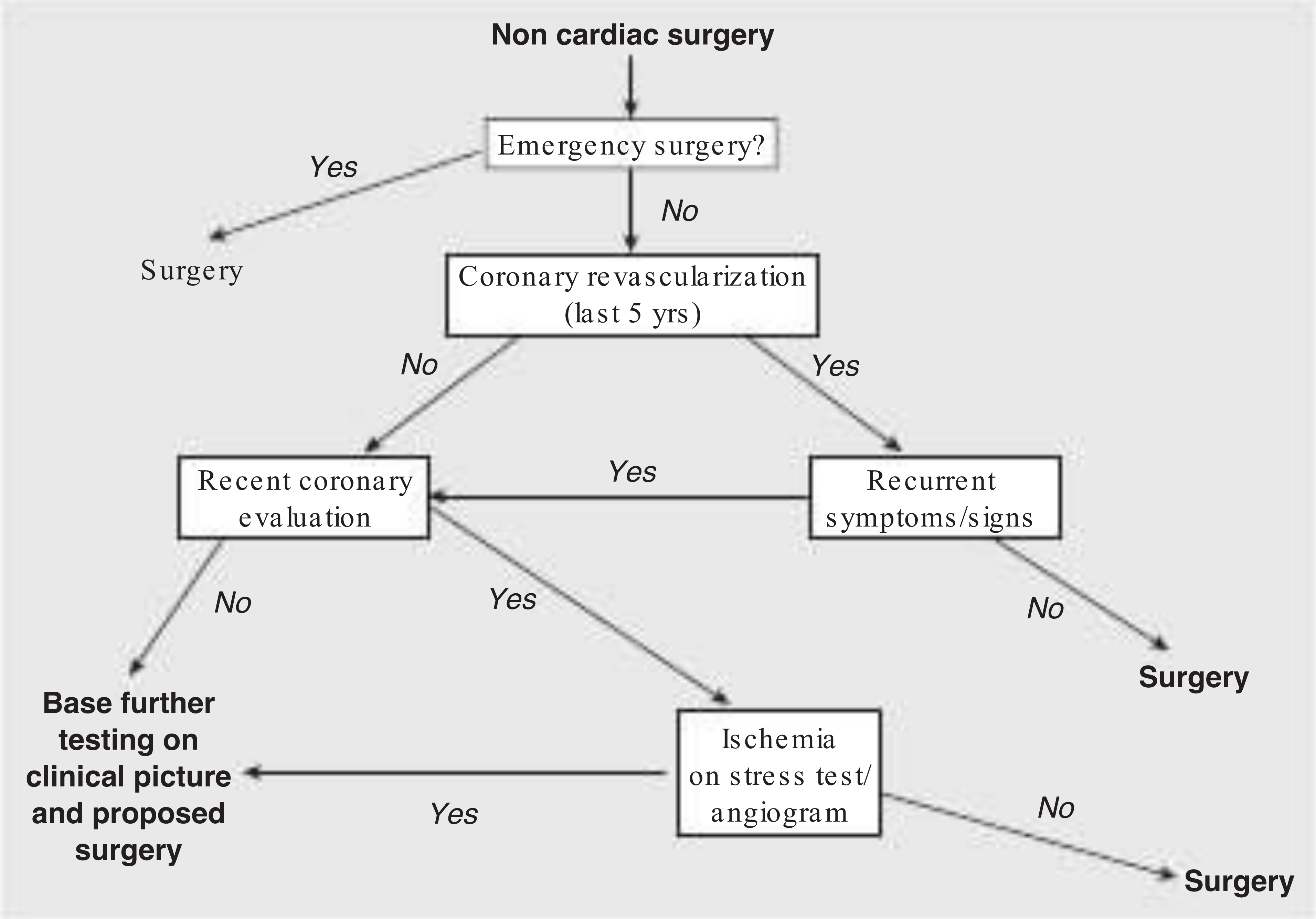

Non cardiac surgery
Emergency surgery?
Yes
Surgery
No
Coronary revascularization (last 5 yrs)
No
Yes
Recent coronary evaluation
Yes
Recurrent symptoms/signs
No
Yes
No
Surgery
Base further testing on clinical picture and proposed surgery
Yes
Ischemia on stress test/ angiogram
No
Surgery

Figure 8.18. Cardiac evaluation.

- Any newly diagnosed pathology should be promptly managed and optimized prior to surgery.
- Patients with uncontrolled conditions such as hypertension, congestive heart failure, sleep apnea, or diabetes should be medically optimized prior to surgery.
- Patients should continue preoperative medications up to the day of the operation, with the exception of anticoagulants (e.g., warfarin), antiplatelets (e.g., aspirin), and antihyperglycemics (e.g., metformin), which should be stopped in coordination with anesthesia.
- Patients on oral steroids should be transitioned to an intravenous dose for the immediate pre- and postoperative period.

CLINICAL box

General Operative risk for Surgery

Low—endoscopic, superficial, cataract

Intermediate—carotid endarterectomy, HEENT, intraperitoneal, intrathoracic, orthopedic

High—emergency, aortic and major vascular, peripheral vascular, prolonged

CLINICAL box

risk of Surgical procedure

Try to evaluate patients as being increased or average risk for a certain surgical procedure rather than fit or unfit for surgery.

SuGGESTED rEADINGS

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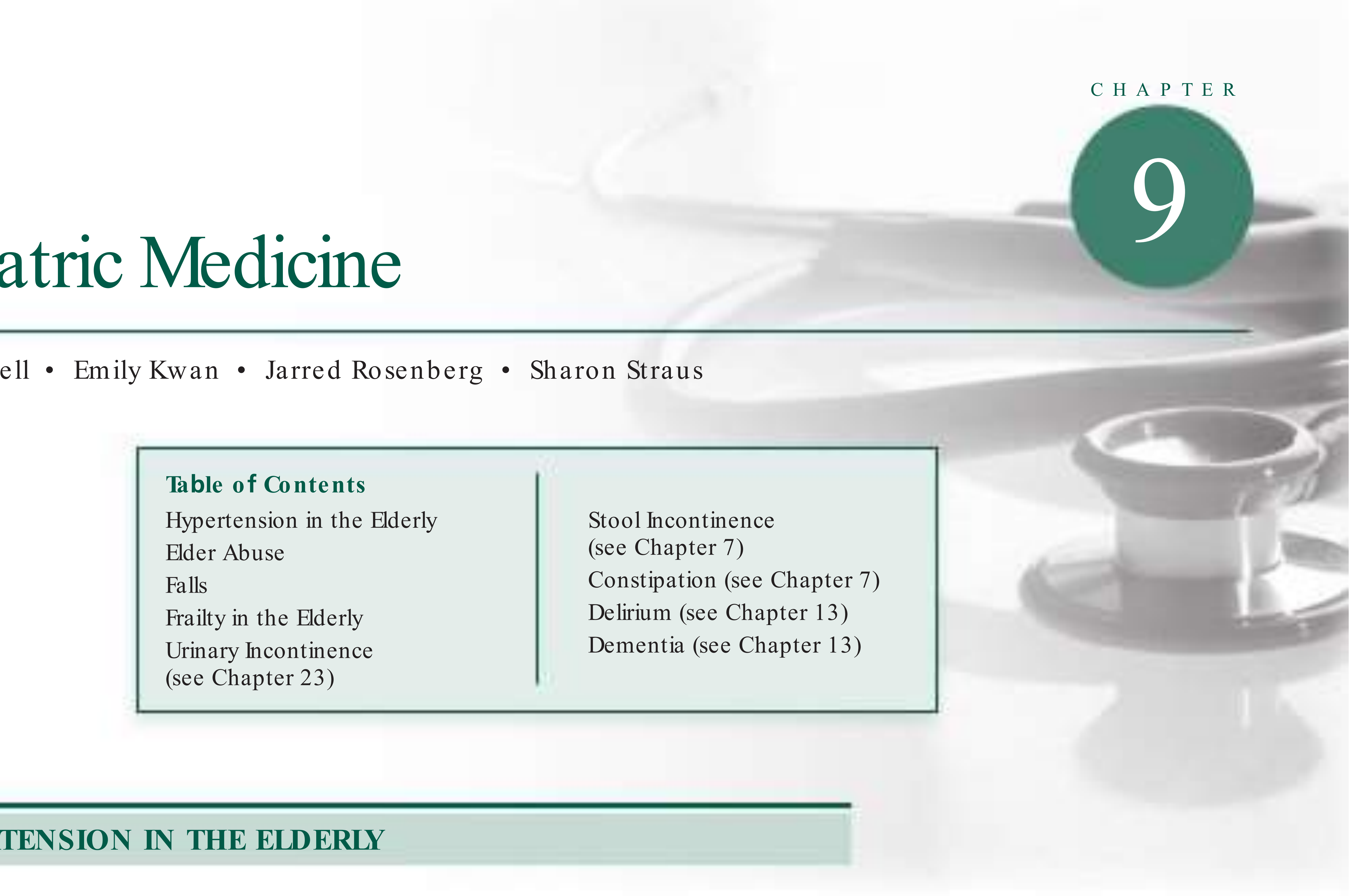

CHAPTER

9

Geriatric Medicine

Dov Gandell • Emily Kwan • Jarred Rosenberg • Sharon Straus

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HYPERTENSION IN THE ELDERLY

MCC OBJECTIVE

Based on Objective #9-1 (Hypertension) of *Objectives for the Qualifying Examination*, 3rd edition.

To be able to diagnose the cause, assess the severity and identify the complications of hypertension in the elderly

To initiate management plans for hypertension in the elderly

OVERVIEW

- A SBP ≥ 140 mm Hg and a DBP ≥ 90 mm Hg on multiple office recordings **or**
- Office SBP ≥ 140 mm Hg and DBP ≥ 90 mm Hg **and** daytime ambulatory blood pressure monitor or home blood pressure monitor SBP ≥ 135 mm Hg and DBP ≥ 85 mm Hg
- Isolated systolic hypertension (ISH) is a SBP ≥ 160 mm Hg and a DBP < 90 mm Hg
- ISH is the pattern of blood pressure elevation most often seen in older adults ≥ 80 y.o. and has a higher treatment target (see below)
- White coat effect refers to transient elevation of blood pressure in the clinician’s office

Epidemiology

- Approximately 19% of the Canadian adult population suffers from hypertension.
- At age 55, the residual lifetime risk of developing hypertension is 90%.
- Over the age of 75, hypertension affects 78% of women and 64% of men.
- With age, a greater proportion of hypertensive patients suffer from ISH.
- Hypertension is the leading risk factor for stroke and other cardiovascular organ damage such as myocardial infarction, congestive heart failure, and atrial fibrillation.

APPLIED SCIENTIFIC CONCEPT

- SBP increases with age.
- DBP peaks and plateaus in late middle-life, then decreases.
- Arteriosclerosis, manifest as remodelling and stiffening of the large elastic arteries, is the most significant aspect of vascular aging that accounts for the rise in SBP and the fall in DBP.
- Structural changes
  - Calcification, collagen deposition, and degradation of elastin within the media of large arteries lead to decreased compliance of arterial walls.
- Functional changes
  - Impaired release and diminished response to nitric oxide, a vasodilator, decreases vessel compliance.

  - Stiffer arteries demonstrate increased pulse wave velocity.
  - Earlier proximal return of pulse waves augments systolic blood pressure.
- Net result
  - Increased systolic blood pressure
  - Decreased diastolic blood pressure
  - Increased or widened pulse pressure

CAUSAL CONDITIONS

- Primary hypertension
- Secondary hypertension important in the elderly (see Chapter 3)
  - Renal artery stenosis
  - Obstructive sleep apnea
  - Primary aldosteronism
  - Hyperthyroidism
  - Lifestyle:
    - Tobacco
    - Alcohol
    - Caffeine
    - NSAIDs
    - Glucocorticoids

APPROACH

In addition to the blood pressure value, the detection of hypertensive end-organ damage and the determination and mitigation of global vascular risk (i.e., the risk of vascular events considering other leading risk factors) are the goals of care.

History

- Similar to younger adults. Also:
  - Identify lifestyle choices (sodium, tobacco, and alcohol consumption, exercise)
  - Isolate orthostatic symptoms (dizziness, lightheaded, syncope, and falls when changing from lying/sitting to standing position)
  - Identify end-organ damage (stroke, myocardial infarction, congestive heart failure, atrial fibrillation, renal failure, retinal pathology)
  - Highlight medications that contribute to high blood pressure

Physical Exam

- Record bilateral blood pressure (if discrepant, under usual circumstances, the higher value is used for treatment decisions)
- Record blood pressure supine, sitting, and standing (after 1 min and 3 min or with symptoms)
- Record height, weight, BMI
- Record waist circumference
  - Place the measuring tape in the horizontal plane at the top of the right iliac crest, then wrap around the abdomen in a snug manner without compressing the skin. Take the measurement at the end of a normal expiration.
- Perform cardiovascular exam with attention to:
  - Elevated jugular venous pressure
  - Displaced or sustained cardiac apical impulse
  - 3rd or 4th heart sound
  - Bruits (carotid, abdominal, femoral, other)
  - Crackles on auscultation of the lungs
  - Pulsatile abdominal mass
- Perform neurologic exam with attention to:
  - Retinal arteriovenular nicking
  - Upper motor neuron findings suggestive of stroke such as focal weakness with velocity-dependent increase in tone and increased reflexes

Investigations

- Urinalysis
- Blood chemistry (potassium, sodium, creatinine)

- Fasting glucose
- Fasting total cholesterol and HDL cholesterol, LDL cholesterol, triglycerides
- Standard 12-lead ECG
- Blood pressure values from ambulatory blood pressure monitors or home blood pressure cuffs can also be used to diagnose hypertension and decrease the risk of treating white coat hypertension or masked hypertension

Management

- Randomized controlled trials support the treatment of ISH in the elderly. Results from one meta-analysis reveal that the number needed to treat for 5 yr to prevent one major cardiovascular event was 18 for men and 38 for women.
- Treat hypertension to recommended targets with lifestyle modifications (see below) and, if targets are not achieved over months, add pharmacologic treatment.
- Recommended targets:
  - SBP ≤ 140 mm Hg in nonfrail older adults ≤ 80 y.o.
  - For frail patients ≥ 80 y.o., SBP 150 mm Hg
  - When starting or titrating pharmacotherapy for ISH, be mindful of DBP < 60 mm Hg as adverse cardiovascular events can be seen with excessively low DBP
- Lifestyle modifications:
  - Reduce foods with added sodium, target < 2300 mg/d
  - Weight loss, BMI $< 25\ \mathrm{kg/m^2}$
  - Waist circumference, < 102 cm (men), < 88 cm (women)
  - Alcohol restriction, ≤ 2 drinks/d
  - Physical activity, 30 to 60 min, 4 to 7 d/wk
  - Dietary patterns, Dietary Approaches to Stop Hypertension (DASH) diet
  - Smoking cessation, smoke-free environment
- Pharmacologic therapy (see Clinical Boxes):
  - Without compelling indications for a specific drug class, choices include:
    - ACEI
    - ARB
    - CCB
    - Diuretic
    - Combination of medications above
    - b-Blockers (BBs) are not recommended as single therapy for patients > 60 y.o.
- Each of the antihypertensives is approximately equally effective in lowering blood pressure.
- Initiating pharmacotherapy at lower doses (e.g., half usual starting dose) in frail elders is suggested.
- Adverse effects from medications are more common in older adults, be vigilant regarding:
  - Hyperkalemia with ACE inhibitors or aldosterone antagonists
  - Hyponatremia with diuretics
  - Orthostatic hypotension with all agents
- Assess and manage global vascular risk in addition to blood pressure.

CLINICAL box

Pharmacotherapy for Hypertension without Compelling Indications

Diuretic
ACEI
ARB
CC

CLINICAL box

Pharmacotherapy for Hypertension with Comorbidity

Compelling Indication	Pharmacotherapy, Choices
Heart failure	Thiazide, BB, ACEI, ARB, CCB, aldosterone antagonist
Coronary artery disease	Thiazide, ACEI, BB, CCB
Angina	BB, CCB
Stroke	Thiazide, ACEI, ARB, CCB
Diabetes	ACEI, ARB, CCB, thiazide, BB
Chronic kidney disease	ACEI, ARB

ELDER ABUSE

MCC OBJECTIVE

Based on Objective #114-2 (Elder Abuse) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Elder abuse is a growing problem in Canada associated with increased morbidity and mortality.
- Identifying and interpreting risk factors and clinical findings are critical in developing an initial management plan and ensuring patient safety.

APPLIED SCIENTIFIC CONCEPT

Interprofessional collaboration with allied health care professionals is essential in the diagnosis and management of elder mistreatment.

DEFINITION

The World Health Organization Toronto Declaration defines elder abuse as "a single, or repeated act, or lack of appropriate action, occurring within any relationship where there is an expectation of trust which causes harm or distress to an older person" (Table 9.1 for Types of Abuse).

TABLE 9.1 • Types of abuse

Type	Definition	Examples
Physical	Acts done causing physical pain, injury, or impairment	Striking, beating, inappropriate use of drugs or physical restraints, physical punishment
Psychological	Acts done with the intention of causing emotional pain or injury	Verbal harassment or assaults, threats, humiliation
Sexual	Nonconsensual acts involving sexual contact	Sexual assault and battery
Material exploitation or financial	Acts involving misappropriation of money, property, or assets	Misuse or theft of money, income, or possessions, coercion or deceiving into signing a financial document or power of attorney
Neglect	Intentional or unintentional failure of designated carer to meet the needs of a dependent older adult	Failure to provide nutrition and hydration or ensure personal hygiene or safety

Adapted from Lachs MS, Pillemer KA. Elder abuse. Lancet. 2004;304:1236–1272.

PREVALENCE, MORTALITY, MORBIDITY

- A 1989 random sample telephone survey of 2008 elderly people in Canada found that 4% of elder adults experienced maltreatment since having reached the age of 65.
- A 1999 survey of family violence in Canada found that approximately 8% of older people had experienced some form of emotional abuse, 1% financial abuse, and 1% physical abuse or sexual assault, at the hands of children, caregivers, or partners during the previous 5 yr.
- In a large longitudinal study of older adults aged > 65 yr, those who were mistreated were 3.1 times more likely to die during a 3-yr follow-up period than those who did not experience abuse, even after adjustment for comorbidity and other factors associated with mortality. At the end of 13 yr of follow-up, 9% of those who were mistreated were alive, compared with 41% who had not experienced abuse.
- Elder abuse is associated with reduction in quality of life and functional status, and various other health outcomes (e.g., depression and earlier placement in a nursing home).

RISK FACTORS (Table 9.2)

TABLE 9.2 • Elder abuse victim and perpetrator risk factors

	Victim Risk Factors	Perpetrator Risk Factors
Individual characteristics	Advanced age (over 75) Gender (women)	Younger age than victim Family member (son/daughter more likely, followed by spouse)
Physical and mental health	Cognitive impairment (i.e., Alzheimer disease and other forms of dementia) Mental illness Functional impairment Chronic disease Difficulty with activities of daily living Increasing care needs	Drug and alcohol use and abuse Untreated psychiatric problems Dementia History of violence or antisocial behavior Poor impulse control
Social/relational factors	Social isolation Dependency on caregiver Living with potentially abusive or exploitative caregivers Lack of close family relationships Lack of community support or access to resources	Personal family stress Caregiver stress Living with victim Dependence on victim for housing, transportation, or income Severe external stress (e.g., loss of job, personal illness)
Economic factors	Inadequate housing or unsafe conditions in the home Evidence of financial exploitation	Financial stress

Adapted from Anthony EK, Lehning AJ, Austin MJ, et al. Assessing elder mistreatment: instrument development and implications for adult protective services. J Gerontol Soc Work. 2009;52(8):815–836.

APPROACH

Elder abuse, like other geriatric syndromes, is a multifactorial and heterogeneous entity that requires comprehensive, interprofessional assessment (Table 9.3).

CLINICAL box

Interprofessional Collaboration

Liaise with social workers, physiotherapist, occupational therapist, pharmacist, and homecare providers to assess risk factors and confirm diagnosis of abuse

TABLE 9.3 • Clinical approach to the diagnosis of elder abuse

	Components of Assessment	Red Flags/Comments
History		
Comprehensive geriatric assessment	Interview older adult independently and assess both elder and caregiver(s) for all of the above risk factors	Delays between injury or illness and seeking medical attention Disparate histories from patient and abuser (e.g., different mechanisms of injury or chronology of events)
	Obtain collateral history (e.g., home care providers, other family members, neighbors)	Implausible or vague explanations Frequent visits to emergency department for chronic disease exacerbations despite care plan and available resources Caregiver who insists on providing history or infantilizes patient Caregiver who provides evasive or defensive responses
Behavioral observation	Participation, body language of older adult, and interaction between older adult and caregiver	Older adult not participating in interview, hesitant to talk openly, exhibiting withdrawn behavior: anxious, trembling, fearful

(continued)

TABLE 9.3 • Continued

	Components of Assessment	Red Flags/Comments
Physical Exam		
General appearance	Assess hygiene, cleanliness, oral health, and appropriateness of dress of older adult	
Skin	Inspect scalp, trunk, and extremities	Multiple skin lesions, bruises, lacerations, welts, and skin ulcers in various stages of evolution Decubitus ulcers with poor wound care Cham and Seow showed that most common presentation of abuse presenting to an emergency department in Singapore was blunt musculoskeletal trauma Wrist or ankle lesions suggest restraint use
Genitourinary		Rectal or vaginal bleeding may suggest sexual abuse
Musculoskeletal	Observe gait and examine for occult fracture and pain	Fractures that are not explained by mechanisms of injury
Psychiatric	Mental status exam to assess for mood disorders	Dyer et al. noted extremely high rates of both depression and dementia in patients referred to a geriatric assessment center for abuse
Neurologic	Formal assessment for delirium and cognitive impairment/dementia	Cognitive impairment suggests delirium or dementia or depression and, if present, requires assessment of decision-making capacity as well as assessing truth of history
Investigations		
Laboratory radiology	As indicated from clinical assessment	Subtherapeutic measurements of drug concentrations (e.g., digoxin, warfarin) despite compliance reported by carer Toxicology reveals psychotropic agents not prescribed. Albumin, blood urea nitrogen, and creatinine may aid in assessing nutrition and hydration.

Adapted from Lachs MS, Pillemer KA. Elder abuse. Lancet. 2004;304:1236–1272.

MANAGEMENT (Figure 9.1 and Table 9.4)

- The Criminal Code of Canada does not include a specific crime of "elder abuse," and there is no federal law that mandates mandatory reporting of elder abuse. As such, disclosure of an adult patient's confidential information requires the person's consent.
- The rules and exceptions with respect to mandatory reporting of elder abuse depend on:
  - What is the province or territory that the older adult lives in?
  - Is the older adult living in the general community or in a care facility?
  - Is the older adult unable to care for himself or herself?
  - Is the issue risky, or has abuse already occurred?
  - Has a criminal act occurred (e.g., fraud, assault, sexual assault, verbal threat)?

FALLS

MCC OBJECTIVE

Based on Objective #32 (Falls) of *Objectives for the Qualifying Examination*, 3rd edition.
To identify a patient who is at risk for a fall
To evaluate and manage a patient who is at risk or who has already suffered a fall

OVERVIEW

Definition

- A sudden and unintentional change in position, resulting in an individual landing at a lower level such as on an object, the floor, or the ground, with or without injury.

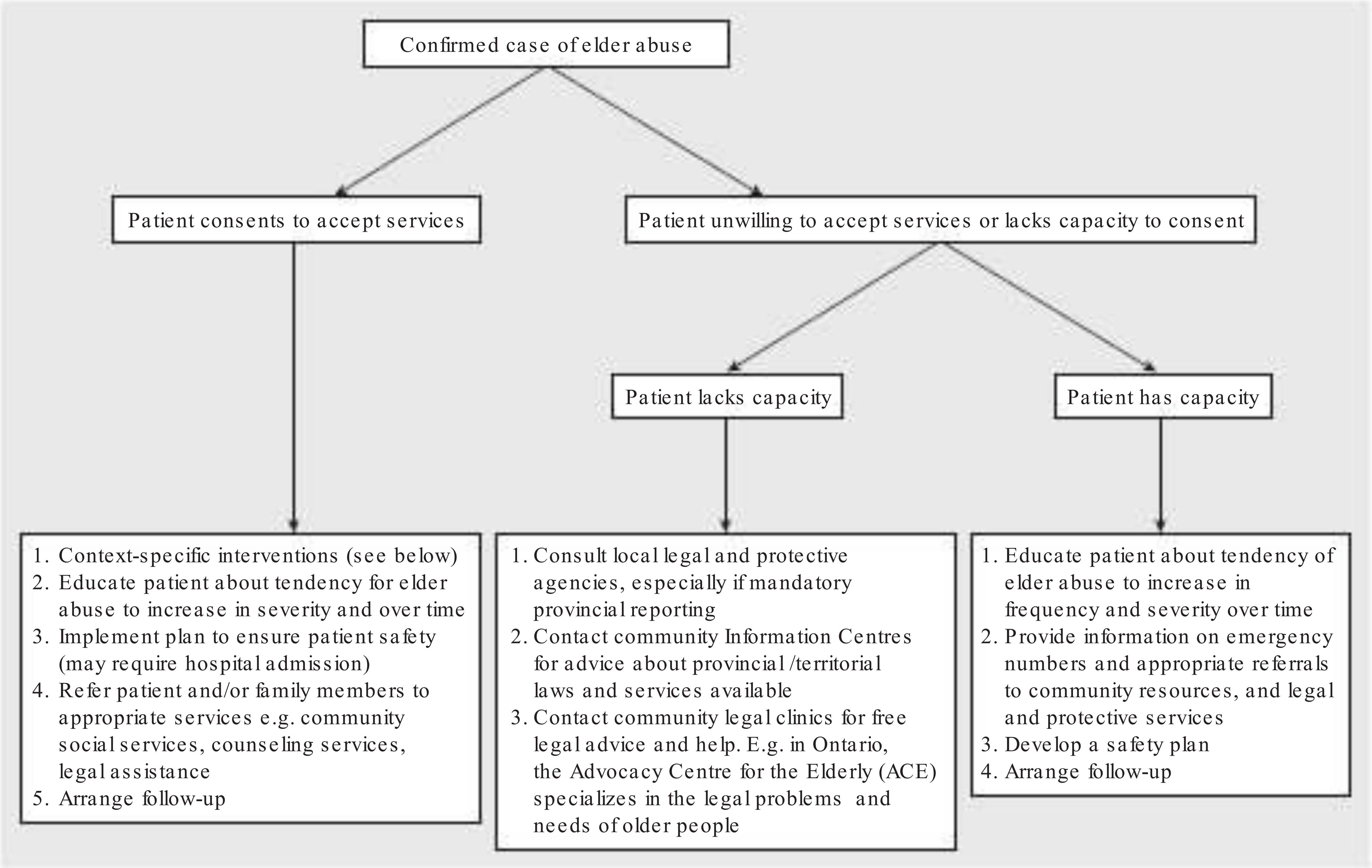
Confirmed case of elder abuse
Patient consents to accept services
Patient unwilling to accept services or lacks capacity to consent
Patient lacks capacity
Patient has capacity
1. Context-specific interventions (see below)
2. Educate patient about tendency for elder abuse to increase in severity and over time
3. Implement plan to ensure patient safety (may require hospital admission)
4. Refer patient and/or family members to appropriate services e.g. community social services, counseling services, legal assistance
5. Arrange follow-up
1. Consult local legal and protective agencies, especially if mandatory provincial reporting
2. Contact community Information Centres for advice about provincial /territorial laws and services available
3. Contact community legal clinics for free legal advice and help. E.g. in Ontario, the Advocacy Centre for the Elderly (ACE) specializes in the legal problems and needs of older people
1. Educate patient about tendency of elder abuse to increase in frequency and severity over time
2. Provide information on emergency numbers and appropriate referrals to community resources, and legal and protective services
3. Develop a safety plan
4. Arrange follow-up

Figure 9.1. Approach to the management of elder abuse. (Adapted from Lachs MS, Pillemer KA. Elder abuse. Lancet. 2004;304:1236–1272.)

TAbLE 9.4 • Interventions in the management of elder abuse

Context of Elder Abuse	Interventions
Abuse related to stress from caring for impaired family member	Respite services Adult day care Care education programs Recruitment of other family, community, or paid caregivers to share burden of care Psychotherapy for caregiver Social integration of caregiver to reduce social isolation
Violence related to mental illness or addiction	Treatment referral
Abuse by aggressive dementia patient	Geriatric medicine and/or psychiatry assessment of causes of underlying behavior
Financial abuse by family member of paid care provider	Referral to legal and protective services

Adapted from Lachs MS, Pillemer KA. Elder abuse. Lancet. 2004;304:1236–1272.

Epidemiology and Consequences

- Approximately 30% of community-living adults aged 65 and older fall each year.
- 12% to 42% of those who fall experience a fall-related injury.
- 10% result in fracture, often due to osteoporosis.
- In addition to physical injury, falls and the fear of falling are associated with functional decline, institutionalization, anxiety, and depression.

APPLIED SCIENTIFIC CONCEPT

Age-related changes to tissues (e.g., retina, inner ear, peripheral nerves), comorbid conditions (e.g., arthritis, stroke), and situational factors (e.g., thresholds, lighting) all contribute to the risk of suffering a fall.

CAUSAL CONDITIONS

Most often, the cause of a fall is multifactorial (i.e., due to many contributing risk factors). The risk factors that are most frequently associated with falls in community-living older adults include:

- Previous fall
- Balance impairment
- Decreased muscle strength
- Visual impairment
- Medications (psychotropic preparations or greater than four prescription drugs)
- Gait impairment
- Depression
- Dizziness or orthostatic hypotension (see below, Physical Exam)
- Functional limitations, ADL disabilities
- Age > 80 y.o.
- Female
- Low body mass
- Urinary incontinence
- Cognitive impairment
- Arthritis

APPROACH

A comprehensive geriatric assessment (CGA—see section on Functional Decline for details) is indicated after a fall. Identifying and mitigating the risk factors and addressing the potential consequences of falls are the main goals of assessment.

Fall History

- The following questions detailing the history of present illness should be answered:
  - Where, when, and how did the fall occur?
  - Was the fall witnessed?
  - Was the event associated with loss of consciousness?
  - Did the skull suffer impact or injury?
  - Were there symptoms immediately prior to the fall (e.g., chest pain, dyspnea, palpitations, weakness, vertigo, dizziness)?
  - What was the length of time spent on the floor?
  - Ability to rise or stand up after the fall
  - Personal emergency response device activation
  - How and by whom was the patient discovered?
  - Onset of gait and balance disturbance and progression
  - Use of gait aid
  - Previous falls
  - Fear of falling
  - Fractures related to falls
  - Previous bone mineral density assessment
  - Identify if an occupational therapy home safety assessment completed in the past
- Medical and surgical history
- Medications
  - Adherence to medications and timing of dose in relation to fall
  - Evaluate the dose and necessity of every drug, particularly medications that exert their effect on the brain or cardiovascular system
  - Typical and atypical antipsychotics
  - Benzodiazepines and other sedative hypnotics
  - Antidepressants
  - Narcotics
  - Antihypertensives
  - Vitamin D
  - Bisphosphonate
- Alcohol

- Functional assessment
  - Activities of daily living
    - Bathroom safety equipment
  - Instrumental activities of daily living
- Social history
- Living arrangement
- Stairs (inside and to access home)

Physical Exam

A complete physical exam is indicated after a fall. Table 9.5 highlights important findings.

TABLE 9.5 • Physical exam after a fall

System	Specific Finding
Vital signs	Bradycardia, hypotension, orthostatic hypotension (see below)
Neurologic	Visual acuity, signs of stroke (visual field deficits, upper motor neuron weakness), signs of parkinsonism (tremor, rigidity, bradykinesia, postural instability), focal weakness, cerebellar tests (nystagmus, dysmetria, dysdiadochokinesis), position sense, Romberg test
Cardiovascular	Orthostatic hypotension is present if there is a systolic pressure drop of at least 20 mm Hg or a diastolic drop of at least 10 mm Hg from supine to standing, after 1–3 min
Musculoskeletal	Injuries, arthritis, range of motion, center of gravity
Gait	Posture, stance (wide/narrow based), speed, stride length, arm swing, turn, footwear
Special tests	Timed Get Up and Go, Berg balance test
Mental status	Mini Mental Status Exam

Investigations

- CBC
- Electrolytes
- Creatinine
- ECG
- Troponin
- TSH
- Vitamin B_{12}
- CT head. Specific indications for a CT scan of the head for patients who have suffered a fall have not been published. The Canadian CT Head Rules for those with minor head injury can be used. Medium- and high-risk individuals should be sent for a CT head (Table 9.6).

TABLE 9.6 • Indications for CT head

Risk Level	Indications for CT Head
High	• Age > 65 • GCS < 15 2 h after injury • ≥ 2 episodes emesis • Suspected open or depressed skull fracture • Signs of basal skull fracture
Medium	• Amnesia prior to impact > 30 min • Dangerous mechanism (fall from height > 3 ft or > 5 stairs, pedestrian versus motor vehicle, ejection from motor vehicle)
Low	• None
Undefined	• Anticoagulation • Focal neurologic deficit

Management

- If the fall was caused by sudden loss of consciousness, the differential diagnosis of syncope should be explored and managed accordingly
- For falls not due to loss of consciousness, the rate (number of falls) and the risk (number of fallers) can be reduced by the following interventions:
  - Multiple-component (e.g., combination of balance and strength) group exercise
    - Rate ratio, RaR, 0.78 (0.71–0.86). Risk ratio, RR, 0.83 (0.72–0.97)
  - Multiple-component home-based individual exercise
    - RaR 0.66 (0.53–0.82), RR 0.77 (0.61–0.97)
  - Tai Chi
    - RaR 0.63 (0.52–0.78), RR 0.65 (0.51–0.82)
- The rate of falls can be reduced by:
  - Assessment and multifactorial intervention (e.g., a multidisciplinary clinic specialized in falls assessment and risk factor modification)
    - RaR 0.75 (0.65–0.86)
  - Antislip shoe device in icy conditions
    - RaR 0.42 (0.22–0.78)
  - Gradual withdrawal of psychotropic medication
    - RaR 0.34 (0.16–0.73)
  - Pacemakers in patients with carotid sinus hypersensitivity
    - RaR 0.42 (0.23–0.75)
  - First eye cataract surgery
    - RaR 0.66 (0.45–0.95)
- The risk of falls can be reduced by:
  - Prescribing modification program for primary care physicians
    - RR 0.61 (0.41–0.91)
- Vitamin D (700–1,000 IU/d) also reduces fall risk
  - Relative risk, RR, 0.81 (0.71–0.92)
- Sensory (vision, hearing) optimization
- Appropriate flat-soled footwear
- A gait aid (walker/cane) fit by a physiotherapist
- A personal emergency response device is suggested to patients who spend time alone and are able to learn how to use it
- An OT home safety assessment is recommended to minimize home safety hazards
- A bone mineral density is required to estimate the 10-yr risk of osteoporotic fracture, which determines the appropriateness of pharmacotherapy to treat osteoporosis

FRAILTY IN THE ELDERLY

MCC OBJECTIVE

Based on Objective #31-1 (Frailty in the Elderly) of *Objectives for the Qualifying Examination*, 3rd edition.

To be able to identify frailty, diagnose and determine the cause, severity, and complications of functional decline. Then initiate a management plan that highlights the importance of a multidisciplinary approach in order to treat the problem.

OVERVIEW

- Frailty, functional decline, and weight loss are unique concepts, but they often occur together.
- Frailty is the variable susceptibility to adverse health outcomes in people of the same chronological age.
- Functional decline refers to individuals' diminished ability to manage their IADL and/or BADL. Consequently, their independence is at risk.
  - The terms *failure to cope* and *failure to thrive* are often inappropriately applied to describe functional decline.
- Weight loss refers to an involuntary decline in body mass. When 5% or more is lost within 12 mo, weight loss is associated with increased morbidity and mortality.

APPLIED SCIENTIFIC CONCEPTS

Frailty

- There are two methods to identify frailty in the clinical setting:
  1. The Fried frailty phenotype is positive when 3 of the following 5 items are present:
     - Unintentional weight loss (10 lb in the past 12 mo)
     - Self-reported exhaustion
     - Weakness (measured as diminished grip strength)
     - Slow walking speed
     - Low physical activity

     At 3 yr, the frailty phenotype was independently predictive of:
     - Incident falls (28% frail vs. 15% not frail, $p < 0.0001$)
     - Worsening mobility (51% frail vs. 23% not frail, $p < 0.0001$)
     - ADL disability (39% frail vs. 8% not frail, $p < 0.0001$)
     - Hospitalization (59% frail vs. 33% not frail, $p < 0.0001$)
     - Death (18% frail vs. 3% not frail, $p < 0.0001$)
  2. A frailty index is the other method to identify frailty:
     - The sum of a number of items considered to be health deficits
     - Divides that sum by the total number of items considered
     - An example is the Canadian Study on Health and Aging (CSHA) Frailty Index.

Functional Decline

- Functional decline is considered to be a sensitive but nonspecific sign of deteriorating health.
- The BADLs (necessary for self-maintenance) include:
  - Bathing
  - Dressing
  - Toileting
  - Eating
  - Walking
  - Transferring from lying to sitting to standing
- The IADLs (necessary for independence in the community) include:
  - Driving and transportation
  - Medication management
  - Control of finances
  - Grocery shopping
  - Meal preparation
  - Laundry and cleaning

CLINICAL box

Potential Contributors to Functional Decline

Disease states (congestive heart failure, stroke, cancer)

Medications (adverse effects)

Cognitive decline (delirium/dementia)

Psychiatric disease (depression/anxiety)

Malnutrition (poor dentition/dysphagia/constipation/access to food)

Decreased mobility

Impaired vision

Impaired hearing

Frailty

Social isolation

Alcohol abuse

Elder abuse (neglect, financial, physical, emotional)

CAUSAL CONDITIONS

- The cause of functional decline can occasionally be attributed to a single condition, such as a large stroke, but is more often the result of many contributing problems.
- It is useful to distinguish whether functional impairment is more significantly influenced by physical disability or cognitive decline.
- Medications as contributors to functional decline deserve close scrutiny as they can often be discontinued or dosed more appropriately.
- Every one unit increase in the Drug Burden Index, a measure of exposure to anticholinergic and sedative medications, predicted:
  - Decreases in short physical performance battery score of 0.08 ($p = 0.01$)
  - Gait speed of 0.01 m/sec ($p = 0.004$)
  - Grip strength of 0.27 kg ($p = 0.004$)

APPROACH

- A comprehensive geriatric assessment (CGA) is indicated.
- The benefits of a CGA in patients admitted to hospital include being more likely to:
  - Be alive and at home at 6 mo (OR = 1.25, 95% CI = 1.11–1.42, $p = 0.0002$)
  - Experience improved cognition (OR = 1.11, 95% CI = 0.20–2.01, $p = 0.02$)

The elements of a CGA include

History

- A knowledgeable informant (family member, friend, power of attorney, assisted living facility worker, family physician, pharmacist) to corroborate the history is often necessary
- Onset and duration of difficulty and rate of progression
- Identify if the problem is significantly influenced by a physical limitation or a cognitive problem
- Screen for depression
- Weight loss, malnutrition
  - Anorexia, dentition, dysphagia, constipation, difficulty procuring food (financial, physical, cognitive), delusions regarding the food itself (e.g., poisoned)
- Vision and hearing
- Review of systems including chronic pain and sleep patterns
- Functional inquiry
  - Baseline and current ability
- Medical and surgical history
- Medication list including prescription, over-the-counter, and natural products
  - How medications are packaged (individual bottle, dosette box, or blister packaging)?
  - Is administration supervised (family, caregiver, assisted living facility)?
  - Identify medications with adverse cognitive effects such as opioids and sedatives
- Alcohol **and tobacco use**
- Social history and supports
  - Family, secular or religious community organizations, financial resources, private support

Physical Exam

- In addition to general medical exam
  - Vital signs (supine, sitting, standing)
  - Weight
  - Visual acuity
  - Inspect external auditory meatus for cerumen
  - Dentition
  - Rectal exam for impacted stool
  - Signs of trauma or abuse

Mental Status

- FMMSE
- Montreal Cognitive Assessment (MoCA)—to date this has been validated in outpatient settings in focused populations

Investigations

- CBC
- Electrolytes, creatinine, calcium, glucose
- TSH
- Vitamin B_{12}
- Liver function tests
- Other tests as indicated by history and physical exam

Management

- Multidisciplinary care is the preferred model.
- Once the list of contributing problems to functional decline is created, various resources are mobilized to attempt to rehabilitate or restore a patient’s previous level of function.
  - Necessary medical tests, treatment, and medication adjustment
  - Pharmacist
    - Medication review (interactions/dosing)
  - Physiotherapy
    - Evaluate and promote mobility
  - Occupational therapy
    - Adaptive equipment
    - Education to overcome functional limitation and promote safety
  - Social work
    - Future planning, power of attorney documentation

        - Community programs
        - Nutritional services (meals on wheels)
        - Financial support
        - Counseling, resources if elder abuse suspected
    - Speech language pathology
        - Food consistency choices
        - Promote articulation and communication in certain circumstances (e.g., poststroke)
    - Dietitian
        - Review caloric requirements and nutrient choices to reach the requirements
- Many programs leverage multidisciplinary care models.
    - Outpatient
        - Day hospitals (a unit where patients receive treatment a couple of hours a day, 2 or 3 d/wk, but return home to sleep)
        - Specialized geriatric clinics (falls, memory)
    - Inpatient
        - Rehabilitation units
        - Acute care medical wards

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CHAPTER

10

Gynecology

Michael W. H. Suen • Nicole Jensine Todd

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AMENORRHEA AND OLIGOMENORRHEA

MCC OBJECTIVE

Based on Objective #56-1 (Amenorrhea, Oligomenorrhea) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Absence or Cessation of Menstruation

- 1°: menstruation that has not started by age 16 in the presence of 2° sexual characteristics or menstruation that has not started by age 14 in the presence of normal 2° sexual characteristics
- 2°: cessation of previously normal menstruation for > 6 mo or no menses for 3 or more normal cycles

CLINICAL box

Normal Menstruation

Menarche—avg. age of onset 12 yr

Menopause—avg. age of onset 51 yr

APPLIED SCIENTIFIC CONCEPT

Stages of puberty: AGTPM

- **A**drenarche: ↑ secretion of adrenal androgens approximately 2 yr pregonadarche
- **G**onadarche: ↑ secretion of gonadal sex steroids (onset at ~8 yr)
- **T**helarche: breast development begins at 9 to 11 yr
  - **Tanner staging for breast development**
    - None
    - Breast bud
    - ↑ Size areola and breasts
    - 2° mound of areola and papilla
    - Areola recessed to contour of breast
- **P**ubarche: pubic and axillary hair development begins at 11 to 12 yr
  - **Tanner staging for pubic hair**
    - None
    - Downy hair along labia
    - Darker/coarse hair extends over pubis
    - Adult-type hair covers smaller areas (no thigh involvement)
    - Adult hair in quantity and type, extends over thighs
- **M**enarche: avg. onset of menses at approximately 12 yr
  - Menarche typically occurs within 2 yr of onset of breast development

CAUSAL CONDITIONS (Table 10.1)

TABLE 10.1 • DDx of 1° and 2° amenorrhea

Body System	1°	2° (In Addition to Etiologies on the Left)
Hypothalamus 35% (↓ FSH/LH)	• Constitutional delay • Stress: ◦ Anorexia/bulimia ◦ Nutritional deprivation ◦ Excessive exercise ◦ Emotional stress ◦ Systemic illness • Hypothalamic tumor • Infiltrate/inflammation/infection/irradiation/surgery of hypothalamus • Congenital GnRH deficiency (i.e., Kallmann syndrome)	• Stress: ◦ Anorexia/bulimia ◦ Nutritional deprivation ◦ Excessive exercise ◦ Emotional stress ◦ Systemic illness • Hypothalamic tumor • Cushing disease • Drugs (i.e., OCP, danazol phenothiazines, neuroleptics)
Pituitary gland 19%	• CNS/pituitary tumor • 1° hypopituitarism • Hyperprolactinemia (with or without prolactinoma) • Irradiation/surgery to pituitary	• Sheehan syndrome (postpartum pituitary necrosis after significant PPH) • CNS/pituitary tumor (i.e., prolactinoma) • Lactation
Thyroid	• Hyper/hypothyroidism	• Hyper/hypothyroidism
Adrenals	• Adrenal tumor—hormone secreting • CAH • Cushing syndrome • Addison syndrome	• Adrenal tumor—hormone secreting • Adult onset CAH
Ovaries 40%	• PCOS (chronic anovulation) • Androgen insensitivity—XY • Gonadal dysgenesis (Turner syndrome XO) • Primary ovarian insufficiency • Irradiation/surgery to ovaries	• Menopause • Primary ovarian insufficiency • Radiation • Testosterone injections • Chemotherapy
Uterine/outflow tract 5%	• Imperforate hymen • Congenital Müllerian duct abnormalities: ◦ Transverse vaginal septum ◦ Vaginal agenesis (i.e., Mayer-Rokitansky-Kuster-Hauser syndrome)	• **pregnancy** • Cervical stenosis • Asherman syndrome (i.e., intrauterine adhesions after endometritis, D&C, or scarring after delivery)

CLINICAL box

Epidemiology of 2° Amenorrhea (when pregnancy excluded)

Ovarian causes—40%
Hypothalamic causes—35%
Pituitary disease—19%
Uterine disease—5%
Other—1%

AppROACH (Table 10.2 and Figures 10.1 and 10.2)

TAbl E 10.2 • Amenorrhea/oligomenorrhea—focused Hx and physical exam

Patient Hx	FHx	Physical Exam

• HPI: menstrual Hx, abdo pain (cyclic or noncyclic)
• Puberty Hx: menarche, thelarche, pubarche
• Gynecologic Hx: contraceptive Hx, sexual Hx, gynecologic surgery Hx (e.g., multiple D&C's)
• Obstetric Hx: GTPAL, postpartum hemorrhage
• Review of systems:
  • CNS mass symptoms: headaches, vision changes, constitutional symptoms
  • Hypothalamus: chronic illness, previous radiation, trauma, diet, exercise, stress, eating disorders, Anosmia (Kallmann)
  • Thyroid: hyper- or hypothyroid symptoms
  • Prolactin: galactorrhea, headaches, vision changes
  • Androgens: hirsutism, acne, male-pattern baldness, voice changes, clitoromegaly
  • Pelvic mass symptoms: abdo pain, early satiety
• Adrenal symptoms: weakness, fatigue, easy bruising, prolonged recovery from illness, striae
• Growth Hx
• Hx of ambiguous genitalia at birth
• Drug intake
	• Menarche
	• Menstrual Hx
	• Parental height
	• Parental pubertal Hx
	• Infertility
	• Genetic defects
	• Low IQ (Fragile X syndrome)
	• Congenital abnormalities
	• Endocrinopathies
		• Vital signs, growth chart, BMI
		• Tanner staging—breast and pubic hair
		• Thyroid gland exam
		• Cranial nerve exam and visual acuity
		• Abdo exam
		• External genitalia (estrogenization, imperforate hymen, atrophic vagina, absence of cervical mucus, etc.)
		• Bimanual exam (enlarged uterus, cystic ovaries, etc.)
		• Acne, virilization, galactorrhea, hirsutism
		• Dysmorphisms (i.e., Turner—web neck, widely spaced nipples)
		• Signs of Cushing disease (striae, central obesity, proximal muscle wasting)

Management of 2° Amenorrhea

- See Table 10.3

DYSMENORRHEA

MCC ObjECTIv E

Based on Objective #56-2 (Dysmenorrhea) of *Objectives for the Qualifying Examination*, 3rd edition.

Ov ERv IEw

Dysmenorrhea is painful menstruation of uterine origin.

- Affects over 50% of menstruating women to some degree
- Can incapacitate approximately 10% of women affected for 1 to 3 d/mo
- Most commonly occurs from age 20 to 25
- Single greatest cause of lost working hours and school days among young women

CLINICAL box

Dysmenorrhea Aggravating Factors

1. Presentation at age < 30
2. Menarche before age 12
3. Longer cycles/duration of bleeding
4. Irregular or heavy menstrual flow
5. Heavy smoking
6. Nulliparity

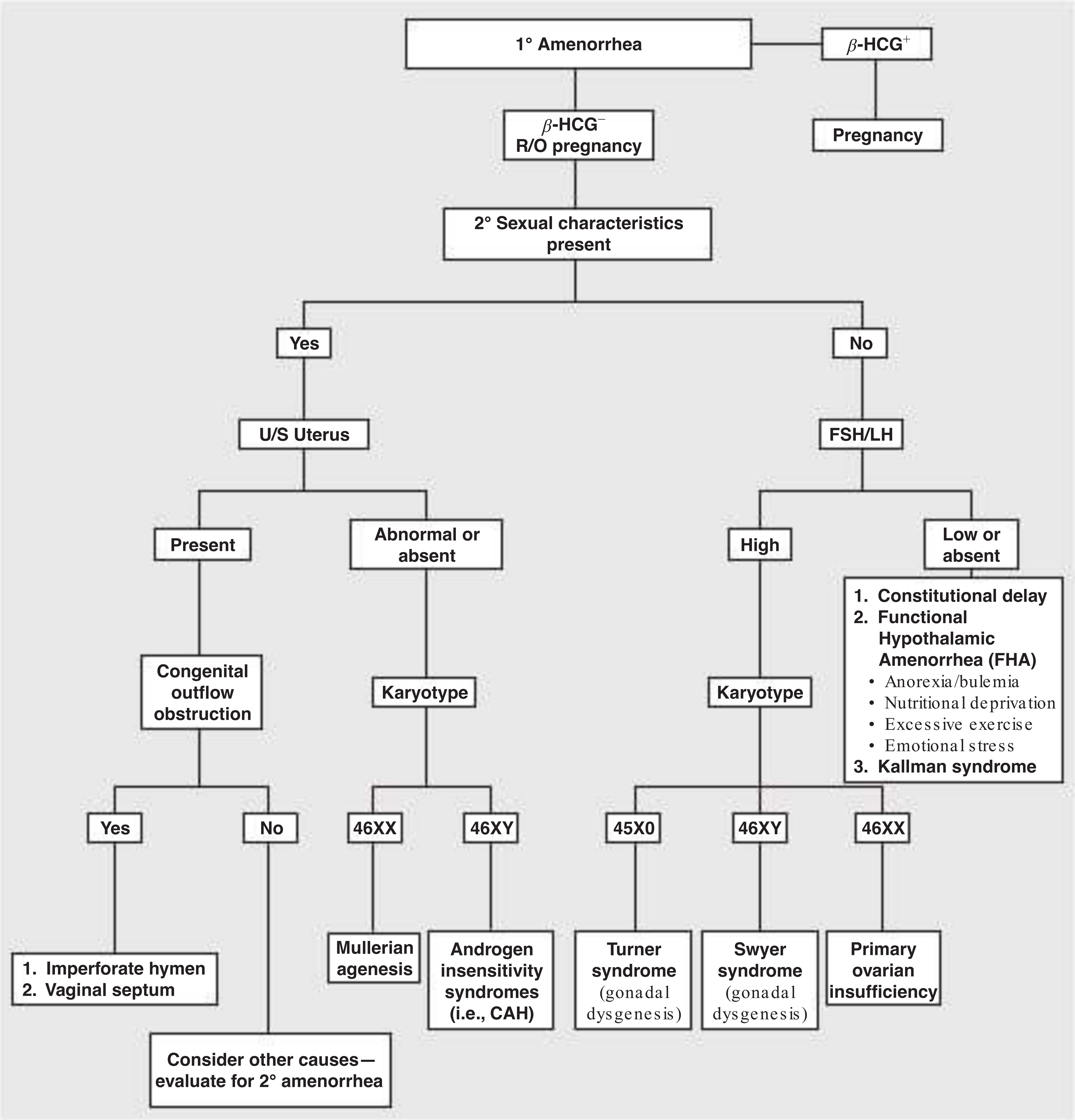

Figure 10.1. Approach to Dx of 1° amenorrhea.

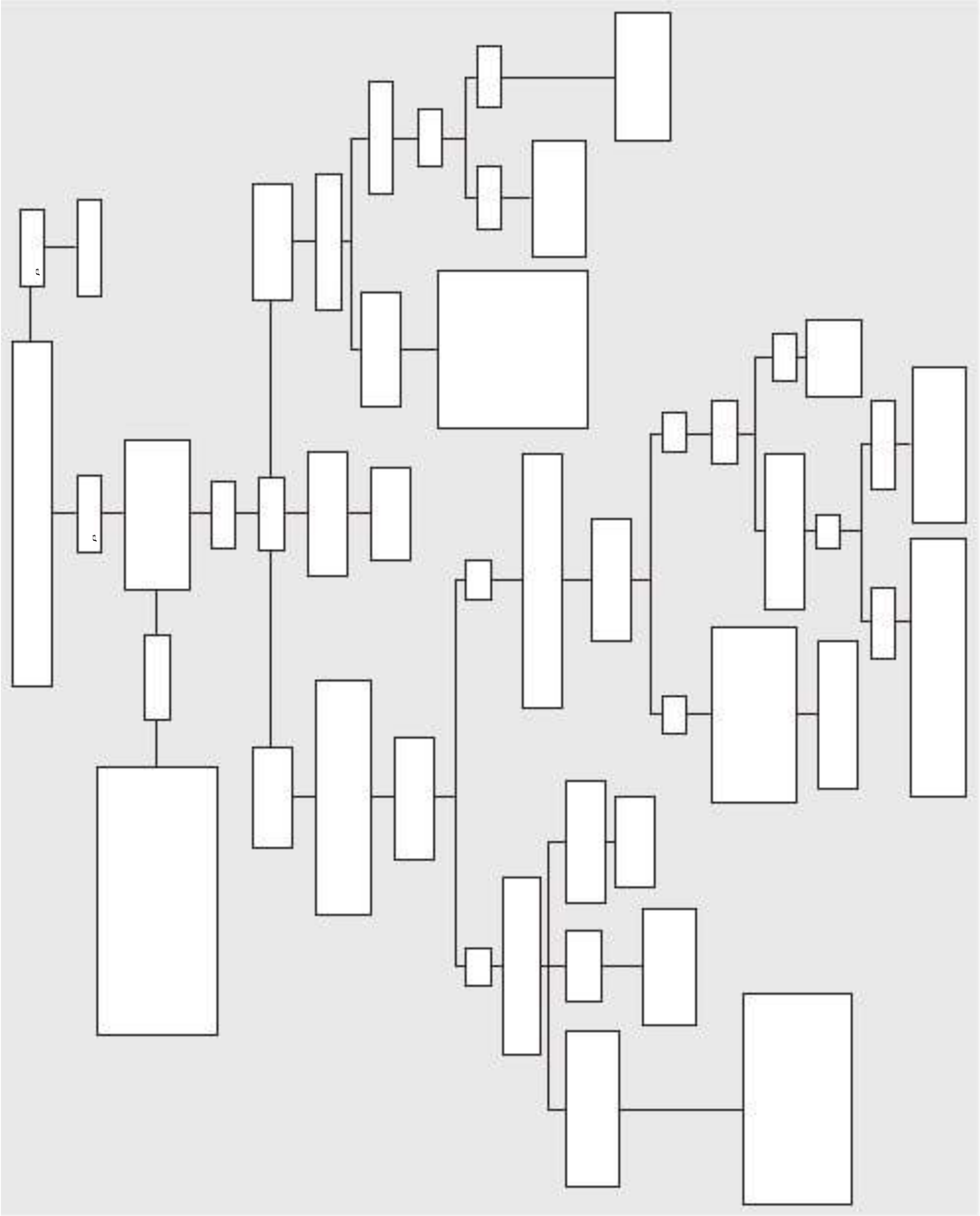
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TABLE 10.3 • Management of 2° amenorrhea

Primary Ovarian Insufficiency (POI) (ä FSH, å E)	Functional Hypothalamic Amenorrhea (FHA) (å FSH, å E)	Endocrinologic Causes (Normal FSH, Normal E)
• Most women with POI retain intermittent ovarian function for many years → can still become pregnant and need counseling on contraception • POI ≠ menopause	• Dx of exclusion (must R/O other causes) • Suppression of pulsatile GnRH secretion from hypothalamus	• Endocrine disorders disrupt hypothalamic–pituitary axis

Rx of POI:
• Patient education (diagnosis)
• Hormone replacement therapy until age of menopause
  • Maintain age-appropriate bone density
  • Cardiovascular health
• Yearly F/U of HRT, TSH levels; bone scan as needed
	Rx of FHA:
	• Patient education
	• Nutritional counseling re: ↑ caloric intake
	• Ca^{2+} and Vit D supplementation if warranted
	• Monitor bone density
	• Referral to eating disorder clinics/specialist if needed
		Rx of underlying etiology:
		• Thyroid hormone replacement or treatment of hyperthyroidism
		• Normalization of prolactin (dopamine agonist ± surgery)
		• OCPs to decrease clinical hyperandrogenism and prevent endometrial hyperplasia in PCOS
		• Steroid replacement in CAH

DYSMENORRHEA CAUSAL CONDITIONS (Table 10.4)

TABLE 10.4 • Classification of dysmenorrhea

	1°	2°
Definition	• Menstrual pain **not** caused by an organic disease • No identifiable pelvic pathology • Occurs in ovulatory cycles • Improves in the third decade of reproductive life and after childbirth	• Menstrual pain caused by an organic disease • Associated with pelvic pathology
Onset	• Begins within 6 mo to 2 yr after menarche	• At menarche (obstructive etiologies) or after age 25 (with pelvic pathology) • Worsens with age (often occurs after years of painless menses)
Etiology	• Pain due to prolonged myometrial uterine contractions and ↓ blood flow to myometrium • These are induced by ↑ prostaglandins (PG) (PGF$_{2a}$, PGE$_2$) production in the secretory endometrium during ovulatory cycles	Multiple etiologies: 1. Endometriosis 2. Adenomyosis (commonly age 30–45) 3. Uterine leiomyomas (degenerating/pedunculated) 4. Nonhormonal IUDs 5. PID 6. Ovarian cysts (e.g., endometriomas) 7. Obstructed outflow tract (i.e., cervical stenosis) 8. Congenital malformations (i.e., bicornuate, septate uterus)
Hx	Pain: • Crampy/colicky • Located in lower abdo, radiates to lower back, labia, and inner thighs • Starts within 1–4 h of onset of menses; lasts 8–72 h • Is present with every menses • Other associated Sx (due to PG excess): nausea, vomiting, diarrhea, low backache, headache, dizziness, fatigue	• Pain onset before menses • Other associated Sx: abdo bloating, pelvic heaviness, back pain • ± Infertility • ± Dyspareunia • ± Dyschezia

TABLE 10.4 • Continued

	1°	2°
Physical exam	• Normal external genitalia • Normal pelvic exam (no adnexal tenderness, masses, or nodules) • No evidence of vaginal anomalies • May have lower abdo pain	• Findings vary based on etiology: 1. Endometriosis: cul-de-sac nodularity or tenderness, adnexal tenderness 2. Adenomyosis: bulky, tender uterus 3. Leiomyoma: enlarged uterus
Rx	• NSAIDs • Hormonal suppression (OCPs, Depo-Provera, Mirena) • Nonpharmacologic (i.e., physical exercise, topical heat, high-frequency transcutaneous electrical nerve stimulation (TENS))	• As per primary dysmenorrhea • Rx of underlying pathology

CLINICAL box

Pelvic Pathology

U/S investigation of pelvic pathology causing dysmenorrhea (2° dysmenorrhea) should be considered if one or more of the following is present:

- Suspicious Hx
- Abnormal physical exam
- Failure of NSAID and/or OCP Rx

APPROACH

- See Figure 10.3

Normal abdo and pelvic exam do not necessarily R/O pathology.

CLINICAL box

First-line Rx: NSAIDs and/or OCPs

- NSAIDs are effective in up to 70% of women.
- Other analgesics may be effective if NSAIDs are contraindicated.
- OCPs can be considered for women who wish to avoid pregnancy.

ABNORMAL VAGINAL BLEEDING

MCC OBJECTIVE

Based on Objective #112 (Vaginal Bleeding, Excessive/Irregular/Abnormal) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Vaginal bleeding is considered abnormal when it*:

- Occurs at an unexpected time—before menarche or after menopause
- Varies from the norm with regard to the amount or frequency of menstrual flow

CLINICAL box

Abnormal Vaginal Bleeding Patterns

Menorrhagia: prolonged (> 7 d) or excessive (> 80 mL) bleeding occurring at regular intervals
Metrorrhagia: bleeding occurring at irregular intervals
Menometrorrhagia: excessive bleeding during normal menstrual period and at other irregular intervals
Polymenorrhea: bleeding occurring at intervals < 21 d
Intermenstrual (IMB): bleeding between regular cycles
Postcoital: bleeding after vaginal intercourse
Postmenopausal: any bleeding following menopause
DVB: abnormal bleeding not due to organic disease (Dx of exclusion)

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*Must exclude the urinary tract and GI tract as sources of bleeding

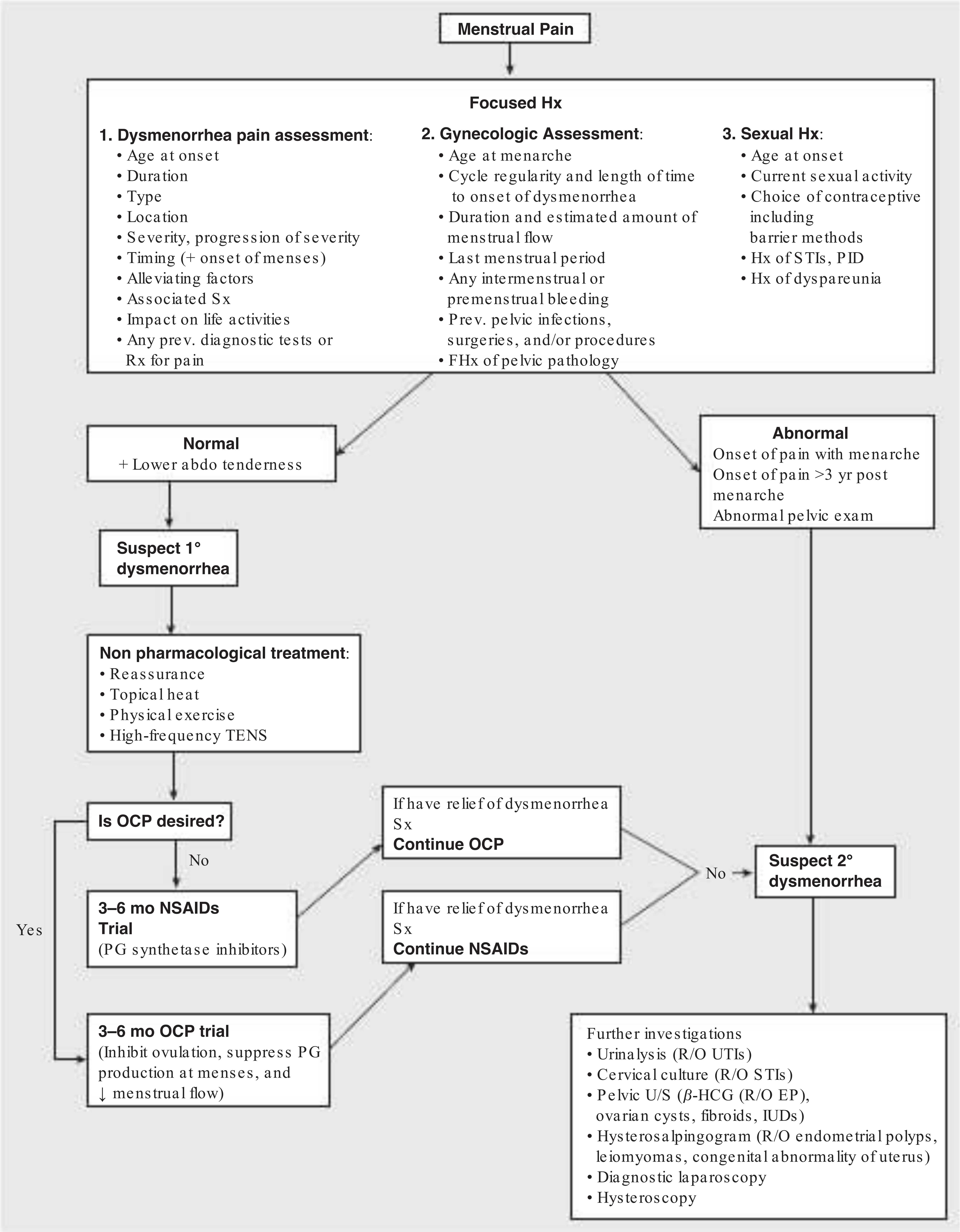

Menstrual Pain
Focused Hx
1. Dysmenorrhea pain assessment:
• Age at onset
• Duration
• Type
• Location
• Severity, progression of severity
• Timing (+ onset of menses)
• Alleviating factors
• Associated Sx
• Impact on life activities
• Any prev. diagnostic tests or Rx for pain
2. Gynecologic Assessment:
• Age at menarche
• Cycle regularity and length of time to onset of dysmenorrhea
• Duration and estimated amount of menstrual flow
• Last menstrual period
• Any intermenstrual or premenstrual bleeding
• Prev. pelvic infections, surgeries, and/or procedures
• FHx of pelvic pathology
3. Sexual Hx:
• Age at onset
• Current sexual activity
• Choice of contraceptive including barrier methods
• Hx of STIs, PID
• Hx of dyspareunia
Normal
+ Lower abdo tenderness
Abnormal
Onset of pain with menarche
Onset of pain >3 yr post menarche
Abnormal pelvic exam
Suspect 1° dysmenorrhea
Non pharmacological treatment:
• Reassurance
• Topical heat
• Physical exercise
• High-frequency TENS
Is OCP desired?
No
Yes
3–6 mo NSAIDs Trial
(PG synthetase inhibitors)
3–6 mo OCP trial
(Inhibit ovulation, suppress PG production at menses, and ↓ menstrual flow)
If have relief of dysmenorrhea Sx
Continue OCP
If have relief of dysmenorrhea Sx
Continue NSAIDs
No
Suspect 2° dysmenorrhea
Further investigations
• Urinalysis (R/O UTIs)
• Cervical culture (R/O STIs)
• Pelvic U/S (β-HCG (R/O EP), ovarian cysts, fibroids, IUDs)
• Hysterosalpingogram (R/O endometrial polyps, leiomyomas, congenital abnormality of uterus)
• Diagnostic laparoscopy
• Hysteroscopy

Figure 10.3. Approach to dysmenorrhea.

APPLIED SCIENTIFIC CONCEPT

Change in Ovarian Function during Life

- Premenopause (menarche—43 yr): normal menstrual cycle
- Perimenopause (~43–49 yr): ↓ # ovarian follicle pool →↓ inhibin →↑ FSH secretion → fewer FSH receptors in a decreased cohort of follicles → poor dominant follicle development → anovulatory cycles
  - Irregular menstrual cycles due to anovulatory cycles
- Menopause (~51 yr): depleted ovarian reserve → chronic anovulatory cycles → E and P deficiency (no corpus leuteum)

CLINICAL box

Normal Menstrual Characteristics

Menstruation length: 7 d or less

Blood loss: 20 to 80 mL/cycle

Cycle length: 21 to 35 d

!

Monthly blood loss > 80 mL may result in Fe^{2+} -deficiency anemia and may affect quality of life.

CAUSAL CONDITIONS (Table 10.5)

TABLE 10.5 • DDx of abnormal vaginal bleeding

Stage in Life	DDx				
Premenarchal	1. Precocious puberty 2. Trauma, sexual abuse, foreign body 3. Vulvovaginal inflammation/infection/dermatoses 4. Other: ovarian tumor, urethral prolapse				
Premenopausal (R/O pregnancy)	**Ovulatory**		**Anovulatory**		
	Intermenstrual	**Menorrhagia**	**Age related**	**Endocrine/ metabolic**	**Other**
	1. **Infection:** cervicitis, endometritis, vaginitis, STIs 2. **Benign growths:** cervical/endometrial polyp, fibroids, ectropion 3. **Malignant tumors:** uterine, cervical, vaginal, vulvar, ovarian 4. **Vulvovaginal etiologies:** infection, dermatoses (e.g., Lichen sclerosis), systemic illnesses (e.g., Crohn's)	1. **Neoplasms:** endometrial CA, uterine sarcoma, fibroids, adenomyosis 2. **Coagulopathies (congenital or acquired)** 3. **Other:** endometritis, hypothyroidism	1. Immature HPO axis 2. Perimenopausal anovulatory cycles	1. **Thyroid:** hyper/ hypo 2. **Chronic disease** 3. **Neoplasms (hormone producing)**	1. PCOS 2. Weight loss 3. Exercise 4. Stress 5. Structural disease
Postmenopausal	**Genital tract disease**			**Drugs**	
	Endometrial CA until proven otherwise 1. Malignant disease: **uterine**, cervical, vaginal, vulvar, ovarian, metastatic 2. Benign disease: atrophic vaginitis, cervical/endometrial polyps, infection 3. Vulvovaginal etiologies as above			1. Hormone replacement 2. Anticoagulants 3. Chemotherapy	

AppROACH (Figures 10.4 and 10.5)

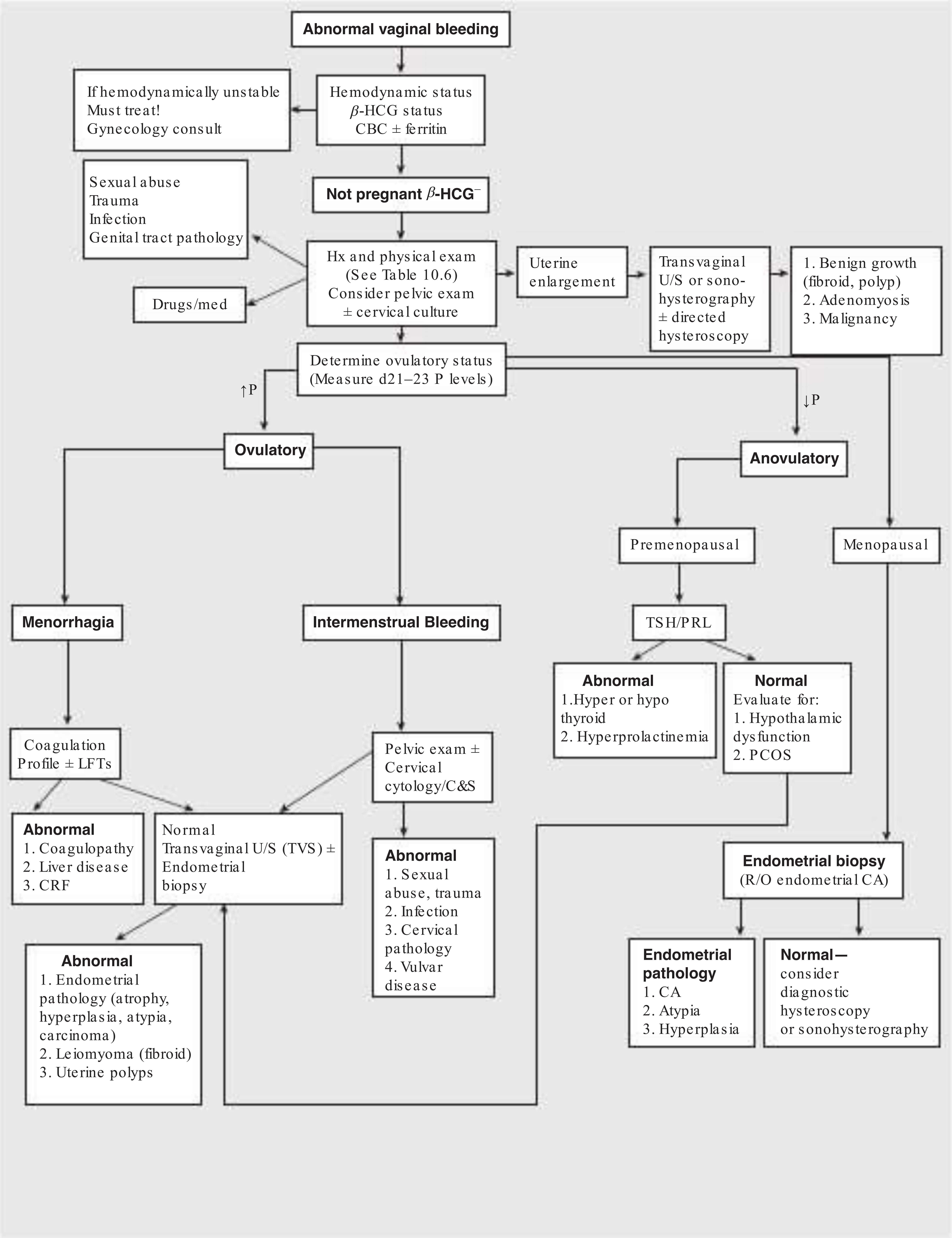
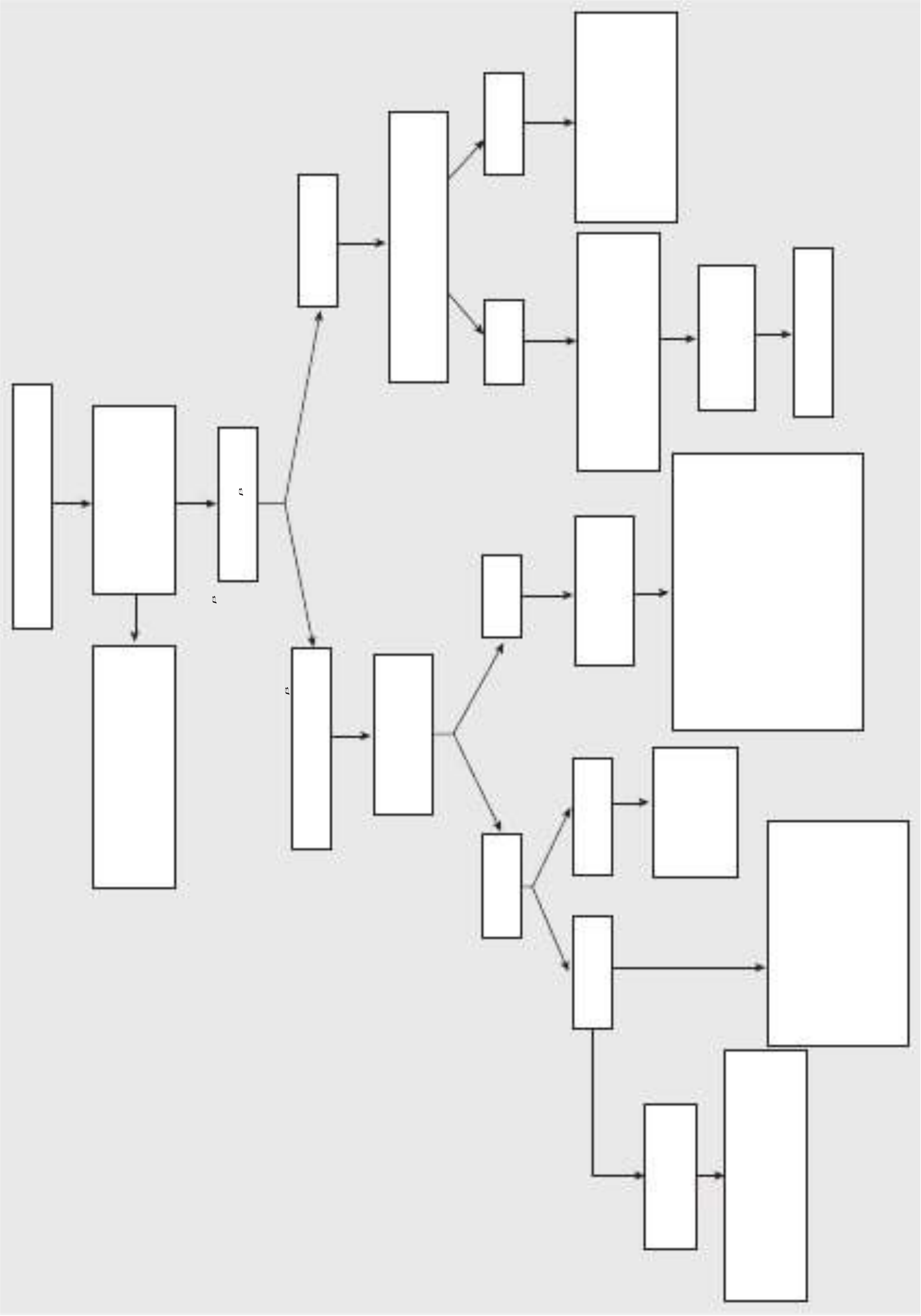


Figure 10.4. Approach to Dx of abnormal vaginal bleeding in nonpregnant women.



History

The most clinically important aspects in the evaluation of patients presenting with abnormal vaginal bleeding are determination of their:

- Hemodynamic status: vitals (BP, HR), signs/Sx (dizziness, pallor, weakness, malaise, dyspnea on exertion, etc.), investigations (CBC, coagulation profile)
- Pregnancy status: b-hCG testing

Hx is helpful, but Dx depends on hormonal, cytologic, and/or radiographic investigations (see Table 10.6).

TAbLE 10.6 • Abnormal vaginal bleeding—focused Hx and physical exam

Menstrual Hx	LMP, cycle regularity, pattern, duration, clots, intermenstrual bleeding, postcoital bleeding, quantity (frequency of pad/tampon changes, flooding)
Associated Sx	Anemia symptoms Pelvic pressure, abdo pain or bloating, early satiety, constitutional symptoms New onset dyspareunia, vaginal discharge, fever
Sexual and pregnancy Hx	Parity, previous C/S Hx of PID/STIs Pap tests
Medical Hx	Coagulopathies Chronic disease (IBD, renal, liver, etc.) Endocrinopathies
Drug Hx	Contraceptives, anticoagulants, HRT
Weight	Δ, diet/exercise Hx
FHx	Breast, endometrial, ovarian or GI cancers Blood dyscrasias
Physical exam	Vital signs, weight, height, general appearance Thyroid Abdo exam External genitalia Speculum exam: swabs for infections and cervical cytology Bimanual exam: adnexal mass, uterine size, tenderness

Indications for U/S

- Women with uterine enlargement identified through pelvic exam
- Any pregnant women with abnormal vaginal bleeding (see CanMED Box)
- Persistent abnormal vaginal bleeding

Indications for Endometrial Biopsy/Cytological Studies

- Women > 40 yr with abnormal vaginal bleeding or **any** postmenopausal bleeding
- Women at high risk of endometrial CA (nulliparity and Hx of infertility, obesity (BMI > 30), PCOS or Hx of oligomenorrhea, FHx endometrial/colon CA, Hx of tamoxifen use)
- Persistent abnormal vaginal bleeding despite a 3-mo course of medical Rx
- Postmenopausal women (including those without bleeding, but with endometrial thickness > 11 mm on TVS)
- F/U of previously diagnosed endometrial hyperplasia or abnormal Pap smear with atypical cells favoring endometrial origin

Indications for Specialty Care Referral

- Persistent abnormal vaginal bleeding
- Endometrial pathology—hyperplasia with or without atypia, CA
- Uterine pathology—fibroids, polyps
- Endocrine disorders—PCOS, hyper/hypothyroidism, hyper-PRL, hypothalamic
- Coagulopathies—1° disease, 2° to liver disease, or CRF

Pelvic exam is contraindicated at > 20 wk of pregnancy with bleeding until U/S has excluded placenta previa.

Can MED

Management

- Tailored to etiology
- Must take into consideration the patient's age, desire to preserve fertility, coexisting medical conditions, and patient preference
- Heavy vaginal bleeding leading to severe anemia and/or hemodynamic instability requires emergency care and specialist referral

Medical Management of Abnormal Vaginal Bleeding (Table 10.7)

Table 10.7 • Medical management of abnormal vaginal bleeding

Cause of Abnormal Vaginal Bleeding	Rx Options	Mechanism of Action
Anovulatory	Low-dose OCP combined	• Cycle regulation • Prevents endometrial hyperplasia
	Cyclic progesterone (to induce withdrawal bleed at least every 90 d): 1. Medroxyprogesterone acetate (**Provera**) 5–10 mg qd × 5–10 d 2. Norethindrone acetate (**Aygestin**) 2.5–10 mg qd × 5–10 d	• Cycle regulation • Prevents endometrial hyperplasia
Ovulatory	1. NSAIDs—start day 1 of menses 2. Antifibrinolytics (tranexamic acid) 1 g q6h during heavy days 3. Levonorgestrel (Mirena) IUD	• Endometrial PG → ↓ menstrual flow • ↓ Menstrual bleeding • Reversible blockade of plasminogen → ↓ menstrual loss

See Pregnancy Loss for management and F/U of threatened miscarriage, EP, and GTD.

Surgical Management of Abnormal Vaginal Bleeding

Indications

- Bleeding refractory to medical Rx
- Patients who are not candidates for hormonal Rx
- Persistent abnormal bleeding in women who have completed childbearing

Surgical Options (When Malignancy Has Been Ruled Out)

- Operative hysteroscopy—removal of intrauterine structural abnormalities
- Endometrial resection or global endometrial ablation
- Myomectomy or uterine artery embolization—Rx of leiomyomas
- Hysterectomy—patient declines medical or conservative surgical management, Rx of atypical hyperplasia

Patient Confidentiality

If sexual abuse is suspected as cause of abnormal vaginal bleeding:

- Reporting is at the discretion of the victim unless victim is a child.
- MD must report abuse of children.
- Before collection of samples for evidence, victims should give informed consent.
- Samples should be stored securely even if the patient decides against reporting the abuse.

PREMENSTRUAL SYNDROME / PREMENSTRUAL DYSPHORIC DISORDER

MCC OBJECTIVE

Based on Objective #56-3 (Premenstrual Dysphoric Disorder [Premenstrual Syndrome, PMS]) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- PMS is the regular monthly experience of physiologic, emotional, and behavioral Sx, which usually occur before the menstrual cycle and are relieved within a few days of its onset (Table 10.8).

TAbLE 10.8 • Sx clusters associated with PMS/PMDD

Physical	Behavioral	Emotional
• Swelling of ankles, hands, or feet • Skin Ds/acne • Insomnia • Nausea/lack of appetite • General malaise and clumsiness • Fatigue, tiredness • Breast tenderness or swelling • Bloating/weight gain • Abdo cramps • ↑ Appetite • Headaches/backaches • Muscle spasms	• Slowed thinking • Poor judgment • Sleep disturbances • Difficulty making decisions • Confusion, forgetfulness • ↑ Desire to be alone, ↓ interest in usual activities • Poor concentration	• Low self-esteem • Paranoia • Moodiness, tearfulness • Anger/rage/hostility • Unwanted thoughts • Sadness, depression • Anxiety, nervousness, panic • Irritability

- PMDD is the most severe form of PMS (Table 10.9).

TAblE 10.9 • Comparison of PMS and PMDD

	PMS	PMDD
Mood symptoms predominant	No	Yes
Difficulty conducting day-to-day activities	No	Yes
Timing	Premenstrual phase only	> 2 consecutive cycles, occurring in the premenstrual phase
Incidence	Up to 75% of women	3%–8% of women of childbearing age
Severity of Sx	Less severe, primarily physical Sx	More severe, primarily mood Sx

- These Sx may be severe enough to interfere significantly with work and/or home activities.
- Incidence: PMS affects up to 75% of women with regular menstrual cycles versus PMDD approximately 3% to 8% of women.

CAuSAL CONDITIONS

- Not well understood
- Current theories:
  - Complex combination of environmental, metabolic, and behavioral factors produce an increased sensitivity to the hormonal changes associated with menstruation.
  - 5-HT interfaces with ovarian hormones: ↑ E → ↑ 5-HT versus ↑ progesterone → ↓ 5-HT
  - Must differentiate between normal premenstrual Sx and other causes of physical and mood changes (i.e., premenstrual exacerbation of underlying psychiatric disorder) (Tables 10.10 and 10.11).

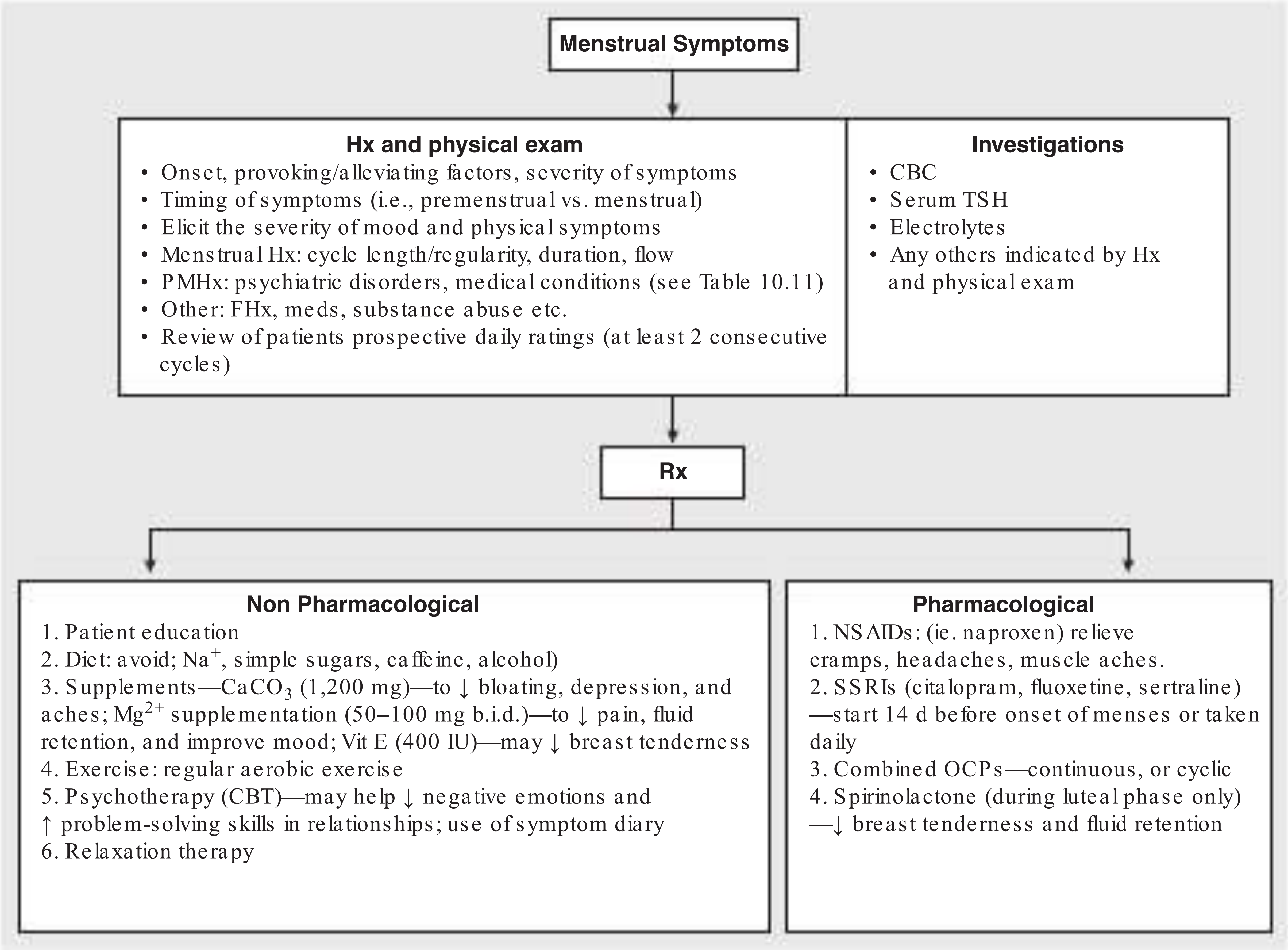
TABLE 10.10 • Classification of PMS spectrum of disorders

Classification	Diagnostic Criteria
PMS	American Congress of Obstetricians and Gynecologists (ACOG) criteria: At least one of the following affective and somatic syndromes during the 5 d before menses in each of the three prior menstrual cycles: • **Affective** → depression, anger (with possible outbursts), irritability, anxiety, confusion, social withdrawal • **Somatic** → headache, tender/swollen/painful breasts, water retention/swelling of extremities, water retention/bloating of the abdomen • Sx are relieved within 4 d of menses onset and not recur until at least day 13 of the subsequent cycle. • Sx not due to any medications including hormones, or drugs or EtOH use • Sx occur reproducibly during 2 cycles of prospective recording. • Patient suffers from identifiable dysfunction in social or economic performance.
PMDD	DSM-V criteria: A. Sx must occur during the week before menses and remit a few days after onset of menses and be absent the week after menses. Five of the following Sx must be present: **%1 of the following 4 Sx:** 1. Markedly depressed mood, feelings of hopelessness, self-deprecating thoughts 2. Marked anxiety or tension 3. Affective lability (i.e., angry outbursts) 4. Persistent and marked anger, or irritability, or ↑ interpersonal conflicts **Along with any combination of the following Sx:** 1. ↓ Interest in usual activities (social withdrawal) 2. Concentration difficulties 3. Marked lack of energy, lethargy, easily fatigued 4. Marked Δ in appetite, overeating, or food cravings 5. Hypersomnia or insomnia 6. Feeling overwhelmed or out of control 7. Other physical Sx (breast tenderness, Abdo bloating, headache, joint/muscle pain) B. Sx must interfere with work, school, usual activities, or relationships. C. Sx must not merely be an exacerbation of another disorder. D. Criteria A, B, and C must be confirmed by prospective daily ratings for at least two consecutive symptomatic menstrual cycles.

TABLE 10.11 • DDx of PMS

Medical Disorders	Psychiatric Disorders
• Anemia • AI diseases (i.e., SLE, MS) • Endocrine disorders (i.e., hypothyroidism, diabetes) • Seizure disorders (i.e., epilepsy) • Migraines and other headaches • Asthma • Pain, IBS • Dysmenorrhea (i.e., endometriosis) • Chronic fatigue syndrome • Collagen vascular disease	• Major/minor depression (dysthymia) • Generalized anxiety • Panic disorder • Bipolar illness (mood, irritability) • Anorexia or bulimia • Substance disorder

AppROACH (Figure 10.6)



Menstrual Symptoms

Hx and physical exam

- Onset, provoking/alleviating factors, severity of symptoms
- Timing of symptoms (i.e., premenstrual vs. menstrual)
- Elicit the severity of mood and physical symptoms
- Menstrual Hx: cycle length/regularity, duration, flow
- PMHx: psychiatric disorders, medical conditions (see Table 10.11)
- Other: FHx, meds, substance abuse etc.
- Review of patients prospective daily ratings (at least 2 consecutive cycles)

Investigations

- CBC
- Serum TSH
- Electrolytes
- Any others indicated by Hx and physical exam

Rx

Non Pharmacological

1. Patient education
2. Diet: avoid; Na^+, simple sugars, caffeine, alcohol)
3. Supplements—$CaCO_3$ (1,200 mg)—to ↓ bloating, depression, and aches; Mg^{2+} supplementation (50–100 mg b.i.d.)—to ↓ pain, fluid retention, and improve mood; Vit E (400 IU)—may ↓ breast tenderness
4. Exercise: regular aerobic exercise
5. Psychotherapy (CBT)—may help ↓ negative emotions and ↑ problem-solving skills in relationships; use of symptom diary
6. Relaxation therapy

Pharmacological

1. NSAIDs: (ie. naproxen) relieve cramps, headaches, muscle aches.
2. SSRIs (citalopram, fluoxetine, sertraline) —start 14 d before onset of menses or taken daily
3. Combined OCPs—continuous, or cyclic
4. Spirinolactone (during luteal phase only) —↓ breast tenderness and fluid retention

Figure 10.6. Approach to PMS.

CONTRACEpTION

CLINICAL box

Pearl Index

The number of contraceptive failures per 100 women years of exposure

MCC ObjECTIvE

Based on Objective #17 (Contraception) of *Objectives for the Qualifying Examination*, 3rd edition.

OvERvIEw

- **Contraception** is protection against conception or impregnation.
- **Contraceptive effectiveness** depends on:
  - Inherent effectiveness in preventing pregnancy
  - How consistently and correctly it is used

History

- As patient compliance is key, a method should be chosen that will match patient needs and preferences.
- Knowing what types of contraception have been used before, if any, and previous side effects, is useful in helping a patient choose a type of contraception that will be used consistently and correctly.
- Hx should also screen for contraindications (Table 10.12).

Physical Exam

- Blood pressure is important to document prior to starting hormonal contraception.
- Based on Hx, patient may need cervical cultures, Pap test, or pregnancy test.

TABLE 10.12 • Contraindications to OCP use

Absolute CIs	Relative CIs
• < 6 wk postpartum if breast-feeding • Breast CA (current) • Smoker > 35 y.o. (> 15 cigarette/d) • Uncontrolled HTN (systolic > 160 mm Hg or diastolic > 100 mm Hg • Venous thromboembolism (current or Hx) • Ischemic heart disease • Valvular heart disease (PulmHTN, Afib, Hx of SBE) • Diabetes with retinopathy/nephropathy/neuropathy • Migraine headaches with focal neurologic Sx • Severe cirrhosis • Liver tumor (adenoma or hepatoma) • Undiagnosed vaginal bleeding • Known thrombophilia • Known or suspected pregnancy	• Smoker over the age of 35 (< 15 cigarette/d) • Adequately controlled HTN • HTN (systolic 140–159 mm Hg, diastolic 90–99 mm Hg) • Migraine headache over the age of 35 • Currently symptomatic gallbladder disease • Mild cirrhosis • Hx of OCP-related cholestasis • Users of medications that may interfere with OCP metabolism

Management

- Reversible contraception can be widely separated into natural family planning, barrier methods, hormonal methods, and intrauterine systems.

Natural Family Planning

- Controlling fertility without contraceptive device or chemicals.
- Different methods and their effectiveness are outlined in Table 10.13.

TABLE 10.13 • Natural family planning methods and effectiveness

Natural Contraceptive Method	Percentage of Women with Unintended Pregnancy	
	Perfect Use	Typical Use
Regular Unprotected Intercourse	85	85
Calendar (periodic abstinence) • Calculate onset and duration of fertile period based on ovulation 12–16 d before menstruation, 5-d sperm survival, and 24-h unfertilized oocyte survival • Avoid intercourse during 8–10 d of cycle	9	24
Ovulation method (periodic abstinence) • Monitor volume and quality Δs in mucus • Mucus becomes clearer and more elastic as ovulation approaches (**spinnbarkeit**), then viscous, opaque, and impenetrable to sperm after ovulation	3	
Symptothermal (periodic abstinence) • Ovulation/cervical mucous method supplemented with calendar method in preovulatory phase and basal body temperature in postovulatory phase • Basal body temperature: ◦ Following the postovulatory elevation in progesterone, basal body temperature should rise by at least 0.5°C.	2	
Lactational amenorrhea • Temporary postpartum method of contraception based on hormonal suppression of ovulation in breast-feeding women (exclusive breast-feeding only)	2	
Coitus interruptus/withdrawal • Male withdraws penis from vagina before ejaculation.	4	27

Barrier Methods

- A mechanical or chemical barrier to impair entry of sperm into upper genital tract (Table 10.14)

TAbLE 10.14 • barrier methods: effectiveness and cautions

	Percentage of Women with Unintended Pregnancy			
Barrier Method	Typical Use	Perfect Use	Mechanism of Action	CIs and Cautions
Male condom • Latex • Polyurethane • Lambskin	18	2	• Mechanical barrier prevents exchange of fluid/semen and ↓ contact of genital lesions. • Prevent pregnancy and STI	• Allergy or sensitivity • **No STI protection** with lambskin or novelty condoms
Female condom • Polyurethane sheath placed in vagina	21	5	• Completely lines vagina • Mechanical barrier prevents exchange of fluid/semen and ↓ contact of genital lesions. • STI prevention similar to male latex condom	• Allergy or sensitivity • Abnormal vaginal anatomy • Inability to insert
Diaphragm • Intravaginal barrier method used with spermicide	12	6	• Physical barrier between sperm and cervix used in conjunction with spermicide • Associated with ↓ cervical neoplasia, dysplasia, gonorrhea, PID, and tubal infertility	• Allergy or sensitivity • Large rectocele, cystocele, or uterine prolapse (↓ efficacy) • ↑ Risk BV and UTI • Vaginal bleeding • Cervical or uterine CA or dysplasia • Current vaginal or cervical infection or PID • Recurrent vaginal, cervical or UTI • Requires specialist fitting and reassessment with changes in weight and parity
Cervical cap • Intravaginal barrier method used with spermicide	23 (Multip) 13 (Nullip)	26 (Multip) 9 (Nullip)	• Silicone cap acts as physical barrier between sperm and cervix used in conjunction with spermicide • Protects against chlamydia and gonorrhea	• Allergy or sensitivity • Vaginal bleeding • Cervical or uterine CA or dysplasia • Current vaginal or cervical infection or PID • Recurrent vaginal, cervical or UTI • Requires specialist fitting and reassessment with changes in weight and parity
Sponge • Intravaginal "one-size-fits-all" barrier method	24 (Multip) 12 (Nullip)	20 (Multip) 9 (Nullip)	• 1° mechanism of action provided by sustained release of spermicide impregnated in sponge • Also absorbs and traps sperm	• Allergy or sensitivity • Abnormal vaginal anatomy or bleeding • Inability to insert • Hx of Toxic-Shock Syndrome (TSS) or recurrent UTI • Does not protect against STIs • Cervical or uterine CA or dysplasia • Current vaginal or cervical infection or PID • Recurrent vaginal, cervical or UTI
Spermicide	28	18	• Made of surfactants that destroy the sperm cell membrane by altering the lipid layer	• Allergy or sensitivity • Should be used with another contraceptive method

- Double protection of including barrier contraception to hormonal contraception or intrauterine system decreases the risk of STIs.

Hormonal Methods

- Contraception can be divided into:
  - Combined hormonal formulations
    - Combined oral contraceptives
    - Transdermal patch
    - Vaginal contraceptive ring
  - Progestin only
    - Progestin-only pill
    - Depo-Provera injection
    - Implantable options (not available in Canada)

The Combined OCP

- Different formulations of OCPs:
  - Monophasic (fixed amount of E and P)
  - Biphasic (fixed amount of E, ↑ amount of P in second half of cycle)
  - Triphasic (fixed or variable amount of E, P ↑ in 3 equal phases)
- With perfect use = 99.9% effective
- With typical use, failure rate ↑ to 3% to 8%
- Effect of body weight on efficacy is controversial
- Contraindications should be considered prior to starting an OCP (see Table 10.12)

Some patients may experience more benefits or side effects from one formulation of OCP over a different formulation due to different levels of E and type of progestin (Tables 10.15 and 10.16).

TABLE 10.15 • OCP—benefits, side effects, and risks

Benefits	Side Effects	Risks
• Cycle regulation • ↑ BMD • ↓ Dysmenorrhea and moliminal Sx • ↓ Menstrual flow (amenorrhea in 2%–3%) • ↓ Acne and hirsutism • ↓ Endometrial cancer • ↓ Ovarian cancer • Fewer ovarian cysts • Possibly fewer benign breast cysts • Decreased ovarian fibroids • Decreased colorectal cancer • Decreased salpingitis	Most resolve in first 3 cycles: • Breast tenderness • Nausea • Irregular bleeding • Chloasma • No evidence for weight gain and/or mood Ds	• Risk of VTE is 9/10,000 compared with nonusers (3/10,000). Highest risk in first year of use. • Stroke and MI (if Ethinyl Estradiol (EE) > 50 mg) • ↑ Gallbladder disease • Breast CA risk controversial • Cervical CA risk uncertain

TABLE 10.16 • Other modes of combined hormonal contraception

Combined Contraceptives	Failure Rate Perfect Use (Typical Use)	Initiation	CI (Same as OCP Plus)	Risks/ Benefits	Side Effects
• **Patch** (Evra) • 200 mg Norelgestromin 35 mg EE/d • Apply to buttock, upper outer arm, lower abdo, upper torso • If patch falls off, reapply new patch • Backup if off >24 h	0.3 (8)	• Start: use backup **unless** start on first day of menses • 1 patch weekly × 3 wk, then 1 wk patch-free week	↓ Efficacy if body weight >90 kg	Same as OCP	• Same as OCP • Breast discomfort • (↑ vs. OCP) • Local skin reaction

(continued)

TAbLE 10.16 • Continued

Combined Contraceptives	Failure Rate Perfect Use (Typical Use)	Initiation	CI (Same as OCP Plus)	Risks/ Benefits	Side Effects
• **vaginal ring** (NuvaRing) • 15 mg EE and 120 mg etonogestrel/d • Effective for up to 4 wk protection	0.3 (6)	• Start: cycle day 1–5 • Left in place × 3 wk, removed for 1 wk • If ring removed > 3 h need backup	• Uterovaginal prolapsed • Vaginal stenosis (prevent retention of ring)	No studies Assumed to be similar	• Same as OCP • Vaginitis • Leukorrhea

CLINICAL box

Good Candidates for p Only

- CI or sensitivity to E
- > 35 yr and smoker
- Migraine headaches
- Breast-feeding
- Endometriosis
- Sickle cell disease
- Anticonvulsant Rx
- Difficulty complying with daily pill (for DMPA)

CLINICAL box

Facts about the OCP

- The P component is predominantly responsible for the contraceptive effect.
- The most common reason patients discontinue the OCP is abnormal bleeding.
- Irregular bleeding that continues beyond 3 mo must be investigated.
- "Pill breaks" are not necessary and ↑ risk of pregnancy.
- Continuous use of pill is safe.
- If pill-free interval > 7 d → ↑ risk of ovulation and conception.
- After discontinuing the pill, patch, or ring, fertility is restored within 1 to 3 mo.
- A pelvic exam is not required before prescribing the OCP.
- No routine lab screening is necessary before prescribing the OCP.

Progesterone-Only Pill (Table 10.17)

TAbLE 10.17 • P contraception

	Injectable P	Oral P
Definition	Depo-provera (DMPA) • 150 mg IM q12 wk • Failure rate < 0.3%/yr	P-only pill/mini-pill 0.35 mg norethindrone • Failure rate = 0.5% with perfect use (must take pill at same time daily) • Failure rate = 5%–10% with typical use • No hormone-free interval
Mechanism of action	• Inhibits secretion of pituitary gonadotropins → suppress ovulation • ↑ Viscosity of cervical mucus • Induces decidualization of endometrium	• Cervical mucus D (↓ volume, ↑ viscosity, alter molecular structure → minimal sperm penetration) • May suppress ovulation (40%) and ↓ receptivity of endometrium
Absolute CI	"PUB": • **p**regnancy known or suspected • **u**nexplained vaginal bleeding • **b**reast CA (current)	• Pregnancy (known) • Breast CA (current)
Relative CI	"ASH": • **A**ctive viral hepatitis • **S**evere cirrhosis • **H**epatic adenoma	• Active viral hepatitis • Liver tumors
Side effects	• Menstrual cycle disturbance (spotting or unwanted amenorrhea) • Hormonal (headache, acne, ↓ libido, nausea, breast tenderness) • Weight gain (~2.5 kg after first year) • Mood (controversial)	• Headache • Bloating • Nausea • Acne • Spotting (most common reason for discontinuing)

Intrauterine Device (Tables 10.18 and 10.19)

- Long-acting reversible contraception
- Lowest failure rate because not compliance dependent (see Tables 10.18 and 10.19)
- Because of such low failure rates, the risk of ectopic pregnancy is low. However, if a pregnancy is conceived with an IUD in place, risk of ectopic pregnancy is high.

TABLE 10.18 • Comparison of IUD available for use in Canada

	Copper IUD	LNG-IUS
Description	Has a vertical stem with a copper wire wound around	Slow release of levonorgestrel (20 mg/d) from small polyethylene T-shaped frame 13.5 mg/d new option, lasts 3 yr
Efficacy (Pearl index)	1.26/100WY	0.09/100WY
Failure rate (%)	0.8	0.1
Duration of effect	5 yr	5 yr
Mechanism of action	• Prevention of fertilization through: ◦ Foreign body reaction (sterile inflammation) → endometrial D causing ↓ sperm transport and impaired implantation ◦ Direct effect of copper ions on sperm motility ◦ ↓ ability to penetrate cervical mucus ◦ Inhibit implantation postfertilization	• Prevention of fertilization through: ◦ Foreign body reaction and endometrial decidualization and glandular atrophy • Endometrial E and P receptor suppression • Thickened cervical mucus as barrier to sperm transport • Some women have ovulation inhibition • Inhibit implantation postfertilization
Side effects	• Pelvic pain (~6% of users will discontinue use due to pain) • ↑ Menstrual flow (up to 65%) • Spotting	• Pelvic pain (~6% of users will discontinue use due to pain) • Depression, headache, acne, breast tenderness (maximal in first 3 mo of use) • ↑ Menstrual flow or spotting in first few months then ↓ bleeding • Functional cysts (~30%)
Benefits		• Decreased menstrual flow (in over 75% of patients) • Decreased endometrial CA • Improved dysmenorrhea • Prevents endometrial hyperplasia in women taking tamoxifen

TABLE 10.19 • CIs to IUD use

Absolute CIs	Relative CIs
• Pregnancy • Current, recurrent, or recent (within 3 mo) PID or STI • Puerperal sepsis • Immediate postseptic abortion • Severely distorted uterine cavity • Unexplained vaginal bleeding • Cervical or endometrial CA • Malignant trophoblastic disease • Copper allergy or Wilson disease (for copper IUD) • Breast CA (for LNG-IUS)	• RFs for STI or HIV • Impaired response to infection • HIV positive • Steroid Rx • From 48 h to 4 wk postpartum (due to expulsion risk) • Ovarian CA • Benign GTD

CLINICAL box

Risks of DMPA

- Delayed return of fertility—average 9 mo delay before full fertility restored
- ↓ BMD—appears to be reversible after discontinuing DMPA

!

Pain may be a physiologic response to device, but possibility of infection, malposition/perforation, or pregnancy should be R/O.

With persistent pain, U/S is used to investigate IUD placement.

CLINICAL box

Ectopic Pregnancy with IUDs

IUD does not ↑ risk of ectopic pregnancy. However, if pregnancy occurs with IUD in place, ectopic must be R/O.

CLINICAL box

Indications for EC

- Failure to use a contraceptive
- Condom break/leakage
- Dislodgment of diaphragm or cervical cap
- Two or more missed pills
- Depo-Provera injection over 2 wk late (> 14 wk)
- Ejaculation on external genitalia
- Mistimed fertility awareness
- Sexual assault (and not using reliable contraceptive method)

CLINICAL box

Facts about EC

- Breast-feeding is not a CI to EC.
- Day of cycle and # episodes of intercourse are not relevant to decision for EC.
- Only known CI to EC is pregnancy (because it is not effective).

Emergency Contraception (EC)

- Any method of contraception which is used after intercourse and before potential time of implantation
- Indications: women wishing to avoid pregnancy and present within 5 d of unprotected sexual intercourse (copper IUD may be considered for up to 7 d)
- Mechanism of action: differs between types of EC and timing of initiation, but can include interference with follicle maturation, ovulation, cervical mucus consistency, endometrial receptivity, corpus luteum support, fertilization, zygote development, transport, and adhesion/implantation

Plan B

- Levonorgestrel-only method (consisting of 2 doses of 750 micrograms taken orally 12 h apart) of 750 mg levonorgestrel taken orally 12 h apart
- Only product approved by Health Canada for EC
- May alternatively take levonorgestrel 1.5 mg orally as a single dose

Yuzpe Method

- Oral administration of 2 doses of 100 mg EE and 500 mg levonorgestrel 12 h apart
- "Ovral" tablets were commonly used to provide these doses, but no longer available in Canada

Postcoital Insertion of Copper IUD

- Can be placed up to 7 d after intercourse to prevent conception and left in place to provide ongoing contraception

Permanent Contraception

- Tubal interruption: 0.2% of women experience an unwanted pregnancy in the first year
- Vasectomy: 0.1% to 0.15% of women experience an unwanted pregnancy in the first year

CLINICAL box

Facts about Permanent Contraception

- Vasectomy is a less invasive and more cost-effective procedure than conventional tubal interruption.
- Although vasectomy and tubal interruption are considered safe and effective, complications may occur and failure is possible.
- Regret after sterilization is not infrequent.
- Counseling before sterilization should include discussion of alternative methods of contraception, risks, complications, potential for regret, possibility of failure and difficulty, expense, and no guarantee of success for reversal.

EARLY PREGNANCY LOSS / SPONTANEOUS ABORTION

MCC OBJECTIVE

Based on Objective #81 (Early Pregnancy Loss/Spontaneous Abortion) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW (Table 10.20)

TABLE 10.20 • Definition of pregnancy loss

Stillbirth	Death that occurs following 20 wk gestation or weighing more than 500 g
Therapeutic abortion	Termination of pregnancy
Spontaneous abortion/ miscarriage	Pregnancy which ends spontaneously before the fetus reaches 500 g or 20 wk gestation
Intrauterine fetal demise	Pregnancy that ends spontaneously after 10–20 wk

- Spontaneous abortion (miscarriage) is one of the most common clinical problems in gynecology.
- 10% to 20% of clinically recognized pregnancies end in miscarriage.

- Loss of unrecognized pregnancies occurs at an even higher rate.
- 80% of miscarriages occur in the first 12 wk of pregnancy.

Risk factors for pregnancy Loss

- GA (↑ risk with earlier age)
- Advanced maternal age
- Previous miscarriage
- Smoking
- EtOH
- Cocaine use
- > 1 alcoholic drink/d
- Caffeine (> 375 mg of caffeine)

Etiology of Spontaneous Abortion

- Blighted or anembryonic pregnancy
- Chromosomal anomalies (50%)
- Teratogen exposure (e.g., maternal diabetes, mercury)
- Trauma (e.g., amniocentesis)
- Uterine factors (e.g., uterine septum, submucosal fibroids)
- Maternal infection/disease
- Maternal endocrinopathies (e.g., hypothyroidism)
- Thrombophilia
- Unexplained

CLINICAL box

Trisomies

The most frequent trisomies in clinical miscarriage are 16, 22, 21, 15, and 13.

!

Above 40 yr of age, the miscarriage rate is estimated at 45%.

AppROACH

Stable or unstable?

- Assess general appearance, vital signs, and clinical status.
- First ensure the patient is hemodynamically stable. Bleeding during miscarriage can be severe.

History

- The patient Hx and physical exam characterizes the extent of bleeding and Sx of anemia and screens for possible causes of abnormal vaginal bleeding (see Table 10.6).
- It is especially important to determine:
  - Estimated gestational age (based on LMP or U/S dating)
  - Presence of abdo cramping and Hx of passing products of conception (liver-like material)
  - Obstetrical Hx including number of prev. pregnancy losses
  - Screen for possible causes for pregnancy loss
- Must exclude the urinary tract and GI tract as sources of bleeding

Physical Exam

- Vital signs and clinical status
- Abdo exam
- Speculum exam is important to look for products of conception and cervical dilation and to R/O nonvaginal source of bleeding

Investigations

- CBC, group and screen, serum b-hCG
- Endovaginal U/S can be useful to investigate location of pregnancy and to assess viability of pregnancy

Diagnosis and Management

- Approach to diagnosis is outlined in Figure 10.5.
- It is important to R/O ectopic pregnancy. See "Pelvic Pain" section for management of EP.

!

The Rh status must always be determined.

Spontaneous Abortion

- The different types and treatment of spontaneous miscarriage are outlined in Table 10.21.
- Management will depend on the stability of the patient, clinical picture, and patient preference.

TAbl E 10.21 • Types of miscarriage

Types of Miscarriage	Definition	Rx
Missed abortion	• Death of the fetus occurring in utero with retention of the pregnancy • Anembryonic pregnancy: a type of missed abortion characterized by a gestational sac with no fetal pole	• D&C • Misoprostol • Expectant management
Complete abortion	• Spontaneous expulsion of all fetal and placental tissue before 20 wk of gestation	• Ensure hemodynamic stability • Supportive
Incomplete abortion	• Incomplete expulsion of the products of conception before 20 wk of gestation	• D&C • Misoprostol
Threatened abortion	• Bleeding occurring during the first 20 wk of gestation without the passage of tissue or cervical dilation • In the presence of fetal cardiac activity, a high proportion of pregnancies continue. • Occurs in 30%–40% of all pregnancies	• Expectant management
Inevitable abortion	• Bleeding ± ROM accompanied by cramping and dilation of the cervix • Gestational tissue may be seen through the internal os.	• D&C • Misoprostol • Expectant management
Septic abortion	• Infection of retained products of conception by S. aureus, GN bacilli, or gram positive cocci • Infection can cause peritonitis and sepsis.	• IV Antibiotics • D&C
Recurrent pregnancy loss	• > 3 spontaneous consecutive first trimester losses	• D&C • Misoprostol • Work-up for recurrent pregnancy loss

Recurrent Pregnancy Loss (RPL)

- RPL is defined as three or more consecutive first trimester miscarriages. RPL affects 5% of couples attempting to conceive.
- In two-thirds of couples with RPL, one or more factors will be identified as being responsible.
- Infertility or advancing maternal age may prompt investigation for RPL after two miscarriages.
- In addition to taking the Hx above, additional information is required to screen for possible causes of RPL, such as:
  - Estimated gestation of each miscarriage (by U/S, LNMP, embryopathology if available)
  - Features of autoimmune disorders
  - Hx of infertility
  - Endocrinologic Hx: Sx of thyroid disease, prolactinoma, or diabetes
  - Toxicologic Hx (including tobacco, EtOH, and caffeine use)
  - Hx of thrombosis
- A variety of factors can contribute to RPL. Diagnostic testing with subsequent treatment options is outlined in Table 10.22.

> ! Close monitoring of the psychosocial well-being of patients with RPL is essential because these patients are susceptible to depression, anxiety, and heightened anger.

Stillbirth (Table 10.23)

- Whereas spontaneous abortion is relatively common, stillbirth is rare, but some risk factors are known (see Table 10.24).
- Management of a stillbirth should be done under consultation by an obstetrician and requires careful consideration and sensitivity to the patient and family members.
- Investigations should be offered but in a timely and respectful fashion (Table 10.25).

Therapeutic Abortion

- Termination of pregnancy that is performed electively due to fetal anomalies, maternal illness, or patient choice.

TABLE 10.22 • Lab investigations for recurrent miscarriage "TIE GAME"

Factor	Diagnostic Test	Rx
1. **T**hrombophilic: • Inherited coagulopathy leading to thrombosis of the intervillous space and spiral arteries	• Factor V Leiden mutation • Prothrombin gene mutation • Homocysteine level • Protein C activity • Protein S activity • Antithrombin activity	• Heparin—LMWH or unfractionated • Folic acid

2. **I**mmunologic	• Antiphospholipid antibodies
	  • Anticardiolipin antibody (IgG/IgM)
	  • b_2-glycoprotein 1 (IgG/IgM)
	  • Lupus anticoagulant
		• ASA
		• Heparin

3. **E**ndocrine		
• DM	• Fasting glucose or $Hb_{(A1c)}$	• Metformin, insulin, hypoglycemic diet
• Thyroid dysfunction	• TSH (hypothyroidism)	• Levothyroxine
• Hyperprolactinemia	• PRL	• Bromocriptine, cabergoline
4. **G**enetic/chromosomal	• Cytogenetic analysis of both partners • (e.g., balanced reciprocal translocation)	• Genetic counseling • Donor gametes • Preimplantation genetic Dx
5. **A**natomic • Septate uterus • Leiomyomas • Intrauterine synechiae (i.e., Asherman syndrome)	• Hysteroscopy • HSG	• Adhesiolysis • Hysteroscopic resection of uterine septum
6. **E**nvironmental/toxicologic	• Review tobacco, ethanol, caffeine use • Review exposure to toxins and chemicals	• Eliminate consumption or exposure

TABLE 10.23 • Stillbirth

Fetal mortality rate	Number of stillbirths per 1,000 total births
Infant mortality rate	Number of deaths of live-born babies in the first year of life per 1,000 live births
Fetal mortality rate in Canada	4.5 per 1,000 total births in 2,000
Etiology	The definitive cause of fetal death is unrecognized in > 25% of cases. However, numerous investigations are recommended following a stillbirth.

- 46 million women have abortions each year. The World Health Organization estimates that half of these are performed unsafely (particularly in third world settings).
- For legal abortions, the risk of death is 1 in 100,000. For ones performed illegally or by nonmedical practitioners, the risk is much higher.
- Methods of therapeutic abortion are outlined in Table 10.26.
- Rh status should be known prior to abortion.
- Complications of D&C/D&E:
  - Bleeding
  - Cervical injury
  - Uterine perforation
  - Endometritis
  - Retained products of conception

CLINICAL box

Abortion may provoke a number of emotions in patients, including relief, guilt, sadness, or depression. It is important to explore these issues with patients. Referral to a mental health professional may be warranted.

TABLE 10.24 • RFs for stillbirth

Maternal RFs	FHx	Fetal Conditions

• Extremes of maternal age
• Nulliparity
• Maternal smoking during pregnancy
• High prepregnancy weight
• Prior fetal loss
• Inadequate prenatal care
• Lower SES
• Reproductive tract infections
• Abdo trauma
• Maternal medical disorders:
  ◦ Thromboembolic disorders
  ◦ DM
  ◦ Hypertensive disorders
  ◦ Thrombophilia
  ◦ AI diseases
  ◦ Epilepsy
  ◦ Severe anemia
  ◦ Severe maternal heart disease
  ◦ Cholestasis of pregnancy
	• Hx of recurrent spontaneous abortions
	• VTE and/or PE
	• Previous child born with a congenital anomaly, abnormal karyotype syndrome
	• Child with documented developmental delay
	• Consanguinity
		• Congenital anomaly
		• Fetal infection (TORCH)
		• Fetal growth restriction
		• Massive placental abruption
		• Maternal-fetal hemorrhage
		• Rh alloimmunization
		• Multiple gestation

TABLE 10.25 • Investigating a stillbirth

Maternal investigations	• CBC • Blood group and antibody screen • Hb$_{(A1c)}$ • Kleihauer-Betke test • TORCH infection serology: toxoplasma, rubella, cytomegalovirus, herpes virus, HIV, hepatitis virus, parvovirus B19 • Karyotype of both parents • Hb electrophoresis (possible thalassemia) • Antiplatelet antibodies (possible alloimmune thrombocytopenia) • DIC screening (INR, PTT, fibrinogen) • Thrombophilia screen 6–8 wk after delivery (as protein levels normally ↓ during pregnancy):
Fetal	• Autopsy (~25% of cases, no cause of death can be identified) • Karyotype • Cytogenetic studies (if have evidence of congenital malformation, IUGR, hydrops, ambiguous genitalia, or dysmorphic features)

Placental	• Careful examination of the placenta:
	  ◦ Chorionicity of the placenta
	  ◦ Thrombosis of the cord/true knot in the cord
	  ◦ Visible abruption, placental infarcts
	  ◦ Placental vascular malformations (vasa previa)
	  ◦ Signs of chorioamnionitis
	  ◦ Bacterial culture of chorion (GBS, Listeria, E. coli)

TABLE 10.26 • Methods of abortion

	Method	Mechanism
First trimester abortion	Vacuum curettage	1. Cervical dilatation using metal dilators ± vaginal misoprostol before procedure 2. A plastic vacuum cannula is placed in the uterus through the cervix and the products of conception are aspirated. 3. Performed under general or local anesthesia, or with conscious sedation
	Misoprostol	Analog of PGE_1 Vaginal administration of 800 mg × 2 (24 h apart) produces complete abortion in 91% of pregnancies up to 56 d of amenorrhea.
Second-trimester abortion (> 13 wk)	D&E	1. Prepare cervix with laminaria (hygroscopic dilator which expands as it absorbs moisture) ± misoprostol to dilate cervix 2. A vacuum cannula is used to extract the fetus and placenta under general anesthetic.
	Labor induction	1. Misoprostol administered vaginally may induce labor—400 mg administered vaginally q6h (highly effective). 2. Dinoprostone (a PGE_2 analog) may also be used.
	Oxytocin	Oxytocin may be used from 17–24 wk of pregnancy.

- Side effects and complications of misoprostol
  - Fever
  - Nausea/vomiting
  - Diarrhea
  - Retained products of conception
  - Bleeding
  - Uterine rupture

MENOPAUSE

MCC OBJECTIVE

Based on Objective #57 (Menopause) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Occurs with the final menstrual period (FMP; a discrete point in time)
- Defined retrospectively as 12 consecutive months of amenorrhea due to loss of ovarian function

CAUSAL CONDITIONS

Periods of Time Surrounding Menopause

- Premenopause: the entire reproductive period before menopause
- Perimenopause: encompasses the period of time (~2–8 yr) characterized by Ds in menstrual regularity and amount of menstrual flow immediately preceding menopause during and the first year after the FMP
- Postmenopausal: the period of time following the FMP (regardless of whether menopause was induced or natural)
- Ovulation ceases → ovaries stop producing estradiol and progesterone but continue to produce testosterone, small amount of E from peripheral conversion (in adipose tissue) of adrenal steroids

C_2LEO

Physician Obligations

Health professionals are not required to perform abortions, but have a duty to share all information and options with their patients, and make appropriate arrangements.

!

Uterine rupture: a few case reports have been reported in patients given misoprostol who have had a previous C/S.

CLINICAL box

Risk factors for Early Menopause

- Smoking (2 yr earlier on avgerge)
- Certain chemotherapy agents
- Radiation
- Hysterectomy and ovarian surgery
- Epilepsy
- Nulliparity

CLINICAL box

Risk factors for Delayed Menopause

- Obesity
- Multiparity
- EtOH use

Types of Menopause (Table 10.27)

TABLE 10.27 • Types of menopause

Natural	Biological process that occurs as part of female aging	• Average age 51 yr • Average woman spends one-third of life post-menopausal
Induced	Surgical removal of ovaries **or** medical ablation of ovarian function	• Iatrogenic • Chemotherapy • Radiation • Oophorectomy
Premature	Occurs at age < 2 SDs below mean age of menopause (before age 40 yr)	• POI = amenorrhea and persistently high FSH

APPROACH

Diagnosis (Tables 10.28 and 10.29)

TABLE 10.28 • Approach to Dx of menopausal/postmenopausal woman

Patient Hx	Pelvic Exam Findings	Investigations
• Menstrual Hx (Δs in volume or duration of flow, date of LMP, abnormal bleeding) • Vaginal Sx (dryness, pruritus, discharge, postcoital bleeding, dyspareunia) • Urinary Sx (dysuria, urgency, ↑ frequency, nocturia) • Vasomotor instability (hot flushes) • Skin/soft tissue Δs • Dx of osteoporosis/osteopenia • Mood and sleep Δs	• Pale, thin, friable vulvovaginal epithelium • Vaginal shortening, smooth, narrow walls, loss of rugae • Vaginal wall or uterine prolapse (secondary to hypoestrogen state and other patient risk factors)	• ↑ Serum FSH • ↑ Serum LH • ↓ Serum estradiol • ↑ Vaginal pH > 6 • Vaginal wall maturation index with ↑ parabasal cells (> 20%) • Endometrial biopsy (if abnormal vaginal bleeding) • Osteoporosis RF assessment (bone densitometry as indicated) • Urine R&M, C&S (if urinary symptoms)

TABLE 10.29 • Features of menopause

Vasomotor	• Hot flushes are sudden onset of warmth that begin in the chest and progress to face and neck lasting ~4 min. May be associated with chills/sweats. • Maximal prevalence within the first 2 yr of menopause, after which prevalence ↓ • Affects up to 85% of women • Possibly hypothalamic origin • Can have major impact on quality of life • Management depends on severity.
Urogenital atrophy	• The hypoestrogen state of menopause results in urogenital aging. • Vulvovaginal Sx: dryness, dyspareunia, thin discharge, pruritus, postcoital bleeding • Urinary Sx: dysuria, urgency, frequency/nocturia • Prolapse Sx: pelvic pressure, introital bulge, constipation, incomplete bladder emptying, low back pain
Skeletal Δs	• Progressive reduction in trabecular > cortical bone mass (osteoporosis) • Prevalence of osteoporosis: 6% at age 50, 50% at age 80 • At 50 y.o. Caucasian female has 40% risk of fragility # (hip, spine, wrist)
Skin and soft tissue	• Thinning of skin/loss of elasticity, regression in breast size • Change in adipose tissue distribution: increased central obesity
Sleep difficulties	• Insomnia (sleep onset and sleep maintenance)
Psychological	• Mood disturbance, anxiety, cognitive difficulties (possibly 2° to hot flush/trouble sleeping)
Hormonal	• ↑ FSH and LH

CLINICAL box

Health Hazards of Menopause

- Osteoporosis is a major consequence of menopause.
- Heart disease is the main cause of death in postmenopausal women.
- All vaginal bleeding that occurs 12 mo after amenorrhea is considered postmenopausal bleeding and requires investigation.

CLINICAL box

Indication for Spine XR in Postmenopausal women

- Historic height loss > 6 cm
- Prospective height loss > 2 cm (↑ kyphosis)
- Acute, incapacitating back pain: to R/O vertebral #

Management of Sx

Vasomotor Sx (85%–95% Resolve within 5 yr)

- Reassurance and lifestyle Ds: Use fans to keep cool, dress in layers, quit smoking, exercise, weight loss if overweight, avoid hot food, caffeine, and EtOH
- Alternative medicine: Evidence lacking for long-term safety/efficacy for black cohosh, dietary soy, phytoestrogens clover, Vit E, kava, evening primrose oil, Chinese herbs
- Nonhormonal Rx: venlafaxine/SSRIs, gabapentin, clonidine, bellergal
- Nonestrogenic hormonal Rx: Ps
- Systemic HRT: Estrogen therapy (ET), estrogen/progesterone therapy (EPT)

Urogential Sx (Generally Worsen with Age)

- Reassurance, patient education, and smoking cessation
- Vaginal moisturizer (polycarbophil gel/Replens)
- Local ET: intravaginal E is the Rx of choice for isolated vaginal Sx (e.g., Vagifem).
  - At recommended dose/frequency do not need to add P

Osteoporosis (Generally Worsens with Age)

- Patient education: exercise, healthy diet, and smoking cessation
- Osteoporosis RF assessment
- Vit D (800 IU/d) and Ca^{2+} supplementation (1.5 g/d): recommended as mandatory adjunct to other pharmacologic Rx to maintain bone density and prevent accelerated bone loss
- Bisphosphonates (alendronate, risedronate): efficacious in ↓ #. First-line Rx in women with osteoporosis, with evidence that they reduce fracture risk
- SERMs: efficacious in prevention and Rx of osteoporosis
- Calcitonin: approved for Rx, not prevention of osteoporosis
- E: ↓ bone resorption, ↑ intestinal Ca^{2+} absorption, ↓ renal Ca^{2+} excretion
  - Estrogen has been shown to improve BMD, but evidence is not conclusive in reducing fracture risk

CLINICAL box

Management Triad

1. Behavioral modifications
2. Nonhormonal medications
3. HRT
   - Oral most effective Rx for severe hot flushes, first-line Rx for women with POI; considered for women with osteopenia and early menopause (< 45 yr)
   - Benefits must outweigh the risks of HRT
   - Reasonable choice in the absence of CI
   - Intravaginal E: first-line Rx for isolated urogenital Sx (does not require progesterone)
   - Nonhormonal Rx is a reasonable choice for women with CI or concerns about HRT

HRT (Table 10.30)

A thorough assessment of individualized risks and benefits is required.

CLINICAL box

factors Not Affecting Menopause

- OCP use
- Age of menarche
- Ethnicity
- Marital status
- Improved nutrition

CLINICAL box

bone Loss

Osteoporosis: BMD > 2.5 SD below young adult mean (T-score at or below −2.5)

Osteopenia: BMD between 1 and 2.5 SD below young adult mean (T-score between −1 and −2.5)

CLINICAL box

Risk factors for Osteoporosis

- Age > 65 yr
- Vertebral compression #
- > 40 yr with fragility #
- Low BMD
- FHx osteoporotic # (especially maternal hip #)
- POI
- Primary hyperparathyroidism
- Systemic steroid use > 3 mo
- Malabsorption, falls, hyperparathyroidism

!

Do not prescribe unopposed E to a woman with an intact uterus

Do not prescribe P alone in patient with breast CA

Do not prescribe for the specific purpose of preventing heart disease

Do not prescribe in the setting of undiagnosed vaginal bleeding

TAbLE 10.30 • Duration of HRT in Rx of menopause

Short-Term Use (, 5 yr)	Longer-Term Use (. 5 yr)
• Appropriate for relieving moderate to severe Sx of menopause if no CI • Avoided or considered second line in those with known CHD, with no other indication for HRT	• Consider risk of breast CA with extended use • Good candidates: individuals with documented or high risk for osteoporosis/osteopenia and no CI • Poor candidates: personal Hx of CHD/CVD, breast biopsy with atypia or CA, first-degree relative with breast CA, BRCA1, BRCA2

- Valid indications include:
  - Moderate to severe menopausal Sx
  - Prevention of osteoporosis, #
- Risks and benefits:
  - Initial support for the use of HRT to prevent CVD, osteoporotic #, colon CA, and dementia was based on observational studies and is now being contradicted by RCTs
- Probable risks:
  - Gallbladder disease
  - Observational studies and RCTs reveal 1.5- to 2.0-fold ↑ in gallbladder disease associated with HRT
- Possible risk/benefits (Table 10.31):
  - Ovarian CA
    - Small, nonsignificant ↑ risk of ovarian CA with EPT (WHI)
  - Cognition
    - E alone does not protect women (> 65 yr) from normal ↓ in cognitive function when compared to placebo.
    - ↓ Cognition, memory, and mood may be 2° to vasomotor Sx (hot flashes, sweats, and difficulty sleeping); therefore, improvement on HRT may be 2° to improvement of vasomotor Sx.
    - Evidence supporting role of HRT in preservation of cognitive function in healthy postmenopausal women or for Rx of Alzheimer disease is weak or absent.
    - Best evidence supports importance of good overall health, maintenance of normal body mass index, reduction of cardiovascular disease risk factors (DM, HTN), avoidance of alcohol excess, and continued cognitive activities.

TAbLE 10.31 • Definite risks and benefits of HRT

Type of HRT	Benefits	Risks
ET and EPT	**Vasomotor Sx:** > 70%–80% improvement **Osteoporosis:** • Prevention of bone loss, # • First-line preventative Rx in postmenopausal women with: a. Low BMD **and** b. Early onset menopause (< 45 yr) • **Note**: risks may outweigh the benefits if used **only** for prevention of postmenopausal osteoporosis. • Second-line Rx for postmenopausal women with osteoporosis	See HRT specific risks **Stroke and VTE:** ↑ risk in healthy postmenopausal women **CAD:** • No benefit for prevention of CAD • ↑ Risk of second CV event in the first year of Rx only • ↑ The risk of CAD in healthy postmenopausal women
ET only	Same as above Local ET (intravaginal): decreases recurrent urinary tract infections	**Endometrial CA:** • ↑ Risk of endometrial CA (unopposed ET). (**Note:** risk ↓ with addition of progesterone)
EPT only	Same as above **Colon** CA: ↓ risk Decreased incidence of new diagnosis of diabetes requiring treatment	**breast CA:** • ↑ Risk of incident breast CA after 5 yr of use • This ↑ risk is felt to return to normal 5 yr after stopping HRT

Based on findings from WHI and/or HERS studies.

- Modes of hormone delivery: cyclic or continuous
  - E (ET): oral/TD/vaginal (TD preferred if ↑ TG, ↓ sex drive)
  - Progesterone (PT): oral/TD/IM/intrauterine (recommend lowest dose for shortest possible time required to treat Sx)
  - Low-dose OC may be prescribed for relief of hot flashes and contraceptive benefit in perimenopause

CLINICAL box

Contraindications to HT

CIs to ET: CULT
- Cancer (breast or uterine)
- Undiagnosed vaginal bleeding
- Liver disease (acute)
- Thromboembolic disease (active)

CIs to PT: PUB
- Pregnancy
- Undiagnosed vaginal bleeding
- Breast CA

Relative CI to Combined HT
- Strong FHx breast CA
- Atypical hyperplasia of the breast, fibroids
- Migraines
- ↑ TGs
- Active gallbladder disease

Vulvar Itch, Vaginal Discharge, and Sexually Transmitted Disease

MCC Objective

Based on Objective #113 (Vaginal Discharge/Vulvar Pruritus) of *Objectives for the Qualifying Examination*, 3rd edition.

Overview

- Vaginal complaints are extremely common in primary care and in gynecology.
- Control of STIs is a major public health concern. Many illnesses are reportable.

Approach

History

- Vulvar Sx (burning or pruritus)
- Vaginal discharge (consistency, color, odor)
- Progression of Sx
- Previous investigations, including cultures, swabs, etc.
- Rx attempted, including antibiotics, antifungals, etc.
- Hygienic practices
- Dysuria (internal vs. external)
- Abdo pain
- Presence of IUD
- Prev. infections
- Menstrual Hx
- Sexual activity, including number of partners, new partners, barrier protection use
- Pregnancy Hx
- PMHx, including Hx of diabetes

! It is imperative to consider the diagnosis and assess any Hx of neoplasia (vulvar/vaginal/cervical/endometrial neoplasia).

Physical exam (Table 10.32)

Table 10.32 • Physical exam of vaginal complaints

Inspect external genitalia	Edema, excoriations, ulceration, condylomas, discharge on the perineum or introitus
Assessment of inguinal and/or femoral lymph nodes	lymphadenopathy
Speculum exam	Vaginal discharge and lesions, evidence of characteristic lesions (e.g., strawberry cervix of trichomoniasis), presence of cervical discharge
Assess the presence of cervical and upper genital tract inflammation	Cervical motion tenderness, adnexal tenderness
Assess the presence of systemic Sx	Fevers, abdo tenderness
Perform perianal inspection, pharyngeal inspection	

Investigations

- Vaginal swabs
- Vaginal discharge sample wet mount
- Culture of the endocervix for gonorrhea or chlamydia infection
- Pap test (biopsy if any suspicious areas)
- Urine R&M, C&S

- Vaginal pH (using phenaphthazine paper)—may be altered by lubricating gel, semen, douches, or intravaginal medication
- CBC, specific blood tests (VDRL, treponemal tests, HSV PCR, HAV, HBV, HIV)

CAUSAL CONDITIONS

Vulvovaginitis

- Inflammation of the vulva and vagina due to both infectious and noninfectious causes (Table 10.33)
- Sx of vaginitis are nonspecific → physical exam and lab findings are required to make a definitive Dx (Table 10.34)

TABLE 10.33 • Types of vaginitis

Infectious Vaginitis	Noninfectious Vaginitis
1. **BV** (40%–50% of cases—most common cause of vaginitis in women of reproductive age) 2. Vaginal candidiasis (20%–25% of cases) 3. Trichomoniasis (15%–20% of cases) 4. Other (less common): • Atrophic vaginitis with 2° bacterial infection • Foreign body with 2° infection • Streptococcal vaginitis (group A) • Ulcerative vaginitis TSS • Idiopathic vulvovaginal ulceration related to HIV	1. Atrophic vaginitis 2. Chemical or other irritant 3. Allergic, hypersensitivity, and contact dermatitis 4. Neoplastic 5. Other: • Traumatic vaginitis • Postpuerperal atrophic vaginitis • Desquamative inflammatory vaginitis • Erosive lichen planus • Lichen sclerosis • Lichen simplex chronicus • Collagen vascular disease, Crohn disease • Behçet syndrome

CLINICAL box

Normal vaginal Discharge

- Physiologic vaginal discharge (1–4 mL of fluid daily)
- pH of normal flora is acidic (4.0–4.5).
- Discharge may ↑ at times (pregnancy, use of E contraceptives, mid-cycle).
  - Normal vaginal discharge ↑ mid-cycle due to ↑ cervical mucus → can be malodorous and can be accompanied by irritative Sx

CLINICAL box

Co-infections

Test for other STIs, including HIV, hepatitis B, and syphilis. Immunize against HPV and hepatitis A and B if not already immunized.

TABLE 10.34 • Dx and Rx of infectious vulvovaginitis

Dx/Causative Agent	Signs and Sx	Diagnostic Criteria	Rx Options
BV • G. vaginalis • Bacteroides • Peptostreptococcus • M. hominis ↑ **Risk of preterm birth** (important to treat in pregnancy)[a]	• Predominant complaint of vaginal odor • ↑ Risk with uterine manipulation	**Amsel criteria** (3 of 4): 1. Thin homogeneous vaginal discharge 2. Clue cells on N/S wet mount or Gram stain 3. Positive Whiff test on KOH wet mount (presence of characteristically "fishy" [amine] odor) 4. Vaginal pH > 4.5	• Metronidazole 500 mg PO b.i.d. × 7 d • Metronidazole 5 g pv daily × 5 d • Clindamycin 5 g pv × 7 d
Vaginal candidiasis • C. albicans • C. glabrata (less common) • Associated with antibiotics use, DM, immunosuppression	• Vulvar/vaginal pruritus • Vulvar erythema, edema, fissures excoriations, external dysuria • Thick flocculent white discharge	1. Normal vaginal pH (4–4.5) 2. Hyphae and buds on saline wet mount (yeast) 3. Positive yeast culture from the vagina (many asymptomatic women have vaginal yeast colonization)	• Fluconazole 150 mg PO once • Clotrimazole 500 mg tablet p.v.× 1 **or** 5 g pv × 3 d
Vaginal trichomoniasis • T. vaginalis[a] • Facilitates HIV transmission, associated with PROM[a]	• Dyspareunia • Vaginal pruritus, vulvovaginal erythema "Strawberry" cervix on exam • Timing: ↑ common during/immediately after menses	1. Trichomonas (motile flagellum) seen on N/S wet mount 2. High number of PMNs on saline microscopy 3. Positive culture for T. vaginalis 4. Vaginal pH 5–6.0	• Metronidazole 2 g PO × 1 • Metronidazole 500 mg PO b.i.d. × 7 d • ***Must** treat sexual partners simultaneously to prevent reinfection!

Sexually Transmitted Infections (Table 10.35)

TAbLE 10.35 • STIs—preventative measures

1°	2°
• Identify at-risk individuals: counseling, education, and assessment • Inform patients about signs and Sx of STIs • Limit the number of sexual partners • Use barrier contraceptives (i.e., male/female condoms, dental dams) • HPV vaccine, hepatitis A + B vaccine • Offer STI screening and testing regularly • Assess the presence of violence or abuse	• HPV vaccine, hepatitis A + B vaccine, postexposure immune globulin for hepatitis B • Consider Post-exposure prophylaxis (PEP) • Detection of infection and Rx • Partner notification and Rx • Mandatory reporting of chlamydia, gonorrhea, chancroid, syphilis, genital herpes, hepatitis B, trichomoniasis (in some jurisdictions), HIV

CLINICAL box

Test for Gonorrhea and Chlamydia

- Sexually active and < 25 yr
- In all patients who have a fever and lower abdo pain
- Asymptomatic sexual partner
- A new sexual partner or more than one sexual partner
- Other STI diagnosed

Gonorrhea and Chlamydia (Table 10.36)

TAbLE 10.36 • Dx and Rx of Gonorrhea and Chlamydia

Dx/Causative Agent	Signs and Sx	Diagnostic Criteria	Rx Options
Gonorrhea ↑[a] N. Gonorrhea (diplococci)	• Cervicitis, PID • Mucopurulent discharge vagina • Rectal pain and discharge • Dysuria, dyspareunia • Perihepatitis (Fitz-Hugh-Curtis) • Lower abdo pain • Abnormal vaginal bleeding • Chorioamnionitis/endometritis • Bartholinitis • Conjunctivitis • Pharyngeal infection • Disseminated infection (arthritis, dermatitis, endocarditis, meningitis)	1. Nucleic acid testing from endocervical specimens (sensitivity 96%) 2. Gram stain of cervical swab sample 3. Culture from endocervix, pharynx, rectum, conjunctiva Usual incubation period is 2–7 d	**Recommended** • Cefixime 800 mg PO × 1[b] **or** Ceftriaxone 250 mg IM × 1 **plus** Azithromycin 1 g PO × 1 **or** Doxycycline 100 mg PO b.i.d. × 7 d **Alternative** Azithromycin 2 g PO × 1 **or** Spectinomycin 2 g IM × 1 **plus** Co-treatment for chlamydia **Mandatory reporting** Rx/F/U of partners with contact within 60 d of Sx onset
Chlamydia ↑[a] C. trachomatis Serotypes D, E, F, G, H, I, J, K (obligate intracellular bacteria)	• Majority of cases → asymptomatic • Vaginal discharge • Dysuria, dyspareunia • Lower abdo pain • Conjunctivitis • Proctitis • Reactive arthritis • Incubation period can be up to 6 wk[b]	1. Nucleic acid testing assay from endocervical, urethral, or urinary specimen 2. Throat and/or rectal culture of C. trachomatis[c]	**Recommended** Doxycycline 100 mg PO b.i.d. × 7 d **or** Azithromycin 1 g PO × 1[b] **Alternative** Erythromycin 500 mg PO q.i.d. × 7 d **or** Erythromycin 250 mg PO q.i.d. × 14 d **Mandatory reporting** Rx/F/U of partners with contact within 60 d of Sx onset

[a] ↑ Over the past decade.

[b] Rx options in pregnancy and lactation.

[c] Should be done in children **or** in circumstances with potential legal implications

CLINICAL box

STI RFs

- Previous STI
- Sexually active < 25 yr of age
- Sexual contact with person(s) with a known STI
- A new sexual partner or > 2 sexual partners in the past year/serially monogamous patients
- IV drug use
- No contraception or sole use of a nonbarrier method
- Sex workers and their clients
- Street involvement, homelessness
- Victims of sexual assault/abuse
- Anonymous sexual partnering
- "Survival sex" (i.e., exchanging sex for money, drugs, etc.)

Must consider sexual abuse in any child diagnosed with gonorrhea and/or chlamydia after the immediate neonatal period. Suspected or known sexual abuse of children must be reported to child protection agencies.

CLINICAL box

Repeat Screening of Gonorrhea Indications

All cases 6 mo post-Rx

Test of cure with culture 3 to 7 d after initiation of treatment when:

- Gonococcal pharyngeal infection
- Patient treated with nonrecommended regimen, including known antimicrobial resistance
- Suspected treatment failure
- Uncertain compliance
- Reexposure to untreated partner
- PID or disseminated infection
- Pregnancy

CLINICAL box

C. trachomatis Repeat Testing

All cases 6 mo post-Rx

Test of cure in 3 to 4 wk recommended when:

- Uncertain compliance
- Patient treated with nonrecommended regiment
- Pregnancy

Test of cure at 3 to 4 wk is *not* recommended when:

- Standard treatment regimen has been completed
- Signs and Sx have resolved
- No reexposure to an untreated partner

Syphilis (Table 10.37)

- Classically painless genital ulcer disease
- The incidence of syphilis has been ↑ nationally over the last 10 yr
- Called the great imitator as it is associated with a variety of signs and Sx

Table 10.37 • Dx and Rx of syphilis[a]

Signs and Sx	Incubation Period	Diagnostic Criteria	Rx Options
1°: chancre (genital ulcer), regional LAD Ulcer is classically **painless** Resolves in 2–8 wk	3–90 d	Dark field microscopy of serous fluid from genital lesions for observation of spirochetes	**1°, 2°, early latent:** • Benzathine Penicillin G 2.4 million units IM × 1[b] • Doxycycline 100 mg PO b.i.d. × 28 d (if allergic to PCN)
2°: widespread symmetric maculopapular rash (palms and soles), fever, malaise, LAD, mucous lesions, condyloma lata, alopecia, meningitis, headaches, uveitis, retinitis	2 wk to 6 mo	Initial **screening** with nontreponemal antibody tests (VDRL and RPR)	• Benzathine Penicillin G 2.4 million units IM × 1[b] • Doxycycline 100 mg PO b.i.d. × 28 d (if allergic to PCN)
Latent: asymptomatic 3°: aortic aneurysm, aortic regurgitation, coronary artery ostial stenosis Early < 1 yr Late > 1 yr	10–30 yr	If nontreponemal tests positive, perform confirmatory testing	**Late latent, CVS syphilis, and other syphilis not involving CNS**: • Benzathine Penicillin G 2.4 million units IM weekly × 3 doses[b] • Doxycycline 100 mg PO b.i.d.× 28 d (if allergic to PCN)
Neurosyphilis (form of 3°): Argyll-Robertson pupil	2–20 yr	The treponemal tests remain positive for life, even after successful Rx.	**Neurosyphilis:** • Penicillin G 3–4 million units IV q4h × 10–14 d[b]
Gumma (form of 3°): tissue destruction in any organ. The specific manifestations depend on the site involved.	1–46 yr	CSF samples should be taken in those with neurologic or ophthalmic Sx.	**Sexual contacts (last 30 d):** • Benzathine Penicillin G 2.4 million units weekly × 3 doses

---

[a] ↑ Over the past decade.

[b] Rx options in pregnancy and lactation.

- Mode of transmission: direct sexual contact with infected lesions, contact with infected blood, vertical transmission (congenital syphilis)
- 1°, 2°, and early latent phases are considered infectious (60% risk of transmission per partner)

CLINICAL box

Syphilis Follow-up Considerations

- Test for other STIs, including HIV, HPV, hepatitis B, chlamydia, and gonorrhea
- Genital ulcers should be tested for HSV, chancroid, and/or lymphogranuloma venereum
- Immunization against HPV and hepatitis A and B if not already immunized
- Syphilis is reportable to public health (1°, 2°, and early latent); sexual and perinatal contacts must be tested

Herpes and Chancroid (Table 10.38)

Classically **painful** genital ulcer diseases

TABLE 10.38 • Dx and Rx of herpes and chancroid

Dx/Causative Agent	Signs and Sx	Diagnostic Criteria	Rx Options
Herpes **HSV types 1 and 2** HSV-1 = oral ulcers ↑ HSV-1 genital infection 2° to ↑ oral-genital intercourse **Must** inform sexual partners from the preceding 60 d before Sx (due to risk of asymptomatic shedding)	• Painful ulcerating genital lesions (80%) • Atypical presentation (20%) including genital pain, urethritis, cervicitis **1° outbreak:** • Painful ulcerative genital lesions • Systemic Sx (fever, myalgias) • LAD • Aseptic meningitis (16%–26%) • Extragenital lesions (10%–28%) **2° outbreak:** • Residual latent sensory ganglion infection leads to late recurrence(s) in tissues innervated by sacral sensory nerves. • Prodromal Sx: itching, burning, tingling, or discomfort • Triggers: stress, illness, or certain medications • Clinical Presentation: systemic sx (16%), ↓ severity/duration of sx, meningitis (1%), extragenital lesions (8%)	• Cultures from HSV lesions (70% sensitive—ulcers, 94%—vesicles) • HSV PCR: 100% specific • Antibody response: early → IgM, followed by IgG • 3–6 wk to seroconversion after 1° outbreak • NAAT assay—vesicle fluid or ulcer swab (~100% sensitivity and specificity) **Measures to ↓ transmission** 1. Counseling (i.e., HSV is not curable, potential for recurrent episodes, sexual transmission, asymptomatic shedding) 2. Condom use 3. Antiviral Rx to ↓ asymptomatic shedding and recurrent lesions NOTE: greatest RF for neonatal herpes → primary maternal genital HSV-1 or -2	**Rx of first episode** Urinary retention may be an indication for hospitalization • Acyclovir 400 mg PO × t.i.d. × 7–10 d • Famciclovir 250 mg PO t.i.d. × 5–7 d If severe: IV acyclovir 5 mg/kg over 60 min q8h until improvement **Rx of recurrent episode (episodic therapy)** • Acyclovir 400 mg PO t.i.d. × 5 d • Valacyclovir 500 mg b.i.d. × 3 d • Famciclovir 125 mg PO b.i.d. × 5 d **Suppressive Rx for nonpregnant patients (6–9 yr)** • Acyclovir 400 mg PO b.i.d. × 6–12 mo • Famciclovir 250 mg b.i.d. × 6–12 mo • Valacyclovir 500 mg daily × 6–12 mo **Suppressive Rx for pregnant patients** Acyclovir 400 mg PO t.i.d., starting at 36 wk gestational age
Chancroid H. ducreyi Known cofactor in HIV transmission	• Painful genital ulcers with granulomatous bases • May progress to inguinal ulcers, painful inguinal LAD **Note:** 50% of those exposed develop the disease (incubation period 5–14 d)	Culture of H. ducreyi Gram stain of GN coccobacilli with "school of fish" pattern Must also R/O T. Pallidum or HSV	Ciprofloxacin 500 mg PO × 1 Erythromycin 500 mg PO t.i.d. × 7 d Azithromycin 1 g PO × 1 Ceftriaxone 250 mg IM × 1 **Must** empirically treat all individuals with sexual exposure in the last 2 wk from onset

HPV: Condyloma Acuminata (Table 10.39)

- HPV is not reportable in Canada
- Once genital warts are healed, routine F/U for cervical CA is recommended
- Consider sexual abuse in children presenting with genital warts
- C/S is not indicated unless warts obstruct the birth canal
- Screen for other STIs

TABLE 10.39 • Dx and Rx of HPV

Signs and Sx	Diagnostic Criteria	Rx Options

• **HPV infection is frequently asymptomatic.**
• HPV lesion: external genital warts (condyloma acuminata)—multifocal cauliflower-like exophytic fronds → ± pruritus or local discharge
  ◦ On cervix, vagina, vulva, or perianal
  ◦ D in size and number of warts with pregnancy
• Intraepithelial lesions on Pap smear → cervical involvement (LSIL, HSIL, invasive carcinoma)
• **HIV:** collaborative care with other specialists is required in patients with HIV due to ↑ risk of cervical CA.
• 90% of patients with external genital warts experience clearance within 2 yr with medical intervention.
	1. **Pap test**
	2. **HPV typing** not indicated for routine Dx/management of visible genital warts. HPV typing is indicated > 30 with ASCUS
	3. **Colposcopy** if HSIL, atypical glandular cells or invasive carcinoma on Pap test or positive high-risk HPV subtype and negative cytology or persistent ASCUS or LSIL × 2 yr
	4. **Anoscopy:** in patients with anal warts due to the risk of anal CA
	5. **Urethroscopy** in patients with extensive urethral warts
	Suspect neoplasia if:
	• Pigmented lesion
	• Bleeding
	• Persistent ulceration
	• Persistent pruritus
	• Recalcitrant lesions
	• Biopsy if lesion suspicious
		No Rx guarantees eradication of HPV
		Patient applied:
		• Imiquimod × 3/wk for up to 16 wk. Cream must be washed off after 6–8 h.
		• Podophyllotoxin 0.5%, 0.5 mL q12h × 3/wk for 6 wk
		Provider-based:
		• Cryotherapy (liquid nitrogen, CO_2)
		• Podophyllin resin 10%–25% for 1–4 h, repeated at weekly intervals
		• Bi- or trichloroacetic acid (50%–80% solution) weekly for 4–6 wk
		• CO_2 laser ablation, excision
		Extensive or resistant lesions:
		• Excision with electrosurgery
		• CO_2 laser removal
		Consider cone biopsy of the cervix, loop electrode excision of the transformation zone if indicated

CLINICAL box

Risk factors for PID

- STI RFs
- IUDs
- Frequent vaginal douching

CLINICAL box

Most common causative agents in PID

- *C trachomatis*
- *N gonorrhea*
- Other: *E coli, Peptostreptococcus, G vaginalis, Prevotella, Bacteroides, Streptococcus, H influenzae, T vaginalis, M genitalium, M hominis*

Pelvic Inflammatory Disease

- Ascending infection of the upper genital tract from the vagina and/or cervix.
- Sx range from asymptomatic to severe Sx.
- Up to two-thirds of cases go unrecognized.
- 10% to 15% of women of reproductive age will have at least one episode of PID.
- PID is the most common infectious cause of lower abdo pain in women.

Sign and Sx

- See Clinical Box (PID Minimum Triad)
- Fever > 38.3°C
- Mucopurulent discharge
- Dyspareunia
- RUQ pain
- Dysuria
- Adnexal mass
- Vaginal bleeding
- Nausea/vomiting
- ↑ ESR, CRP
- WBC > $10{,}000/mm^3$
- Lab confirmation of cervical Dx of chlamydia and/or gonorrhea
- See complications in Table 10.40

TABLE 10.40 • Complications of PID

Acute complications	• Pelvic peritonitis • Endometritis • Salpingitis • Tubo-ovarian abscess • Sepsis
Chronic complications	• Infertility • Chronic pelvic or abdo pain • Pelvic/Abdo adhesions • Fitz-Hugh-Curtis syndrome • EP

Management

Medication (Table 10.41)

TABLE 10.41 • Rx options for PID

Inpatient Rx	1. Cefotetan 2 g IV q12h + doxycycline 100 mg PO b.i.d. until clinical improvement > 24 h, then continue doxycycline PO only for a total of 14 d 2. Cefoxitin 2 g IV q6h + doxycycline 100 mg PO b.i.d. until clinical improvement > 24 h, then continue doxycycline PO only for a total of 14 d 3. Clindamycin 900 mg IV q8h + gentamicin 2 mg/kg IV load, then 1.5 mg/kg IV q8h until clinical improvement × 24 h, then doxycycline 100 mg PO b.i.d. or clindamycin 450 mg PO q6h for a total of 14 d **Note:** consider adding metronidazole 500 mg PO b.i.d. × 14 d to all the above regimens
Outpatient Rx	1. Ceftriaxone IM × 1 + either doxycycline 100 mg PO q12h × 14 d **or** azithromycin 1 g PO × 1 dose, then q weekly × 2 wk 2. Cefixime 800 mg PO × 1 dose + either doxycycline 100 mg PO q12h × 14 d **or** azithromycin 1 g PO × 1 dose, then q weekly × 2 wk 3. Levofloxacin 500 mg PO b.i.d. × 14 d **Note:** consider adding metronidazole 500 mg PO b.i.d. × 14 d to all the above regimens

CLINICAL box

Gold Standard Dx

Laparoscopy demonstrating abnormalities consistent with PID, including fallopian tube erythema and/or mucopurulent exudates

CLINICAL box

Criteria for Inpatient Rx

- Pregnancy
- Appendicitis/EP cannot be excluded
- Adolescence/poor compliance
- Inability to follow or tolerate an oral regimen
- If pelvic or tubo-ovarian abscess is suspected
- Patient previously failed to respond to outpatient Rx
- Patient is immunocompromised
- Dx is uncertain (i.e., need for laparoscopy)
- The patient has severe illness (vomiting, fever, pain)
- HIV-positive patient

CLINICAL box

PID Minimum Triad

Lower abdo pain + one of the following:

- Adnexal tenderness
- Cervical motion tenderness
- Uterine tenderness

CLINICAL box

Fitz-Hugh-Curtis Syndrome

Perihepatitis resulting in adhesions between the liver capsule and the abdo wall. Perihepatitis resolves with Rx of PID.

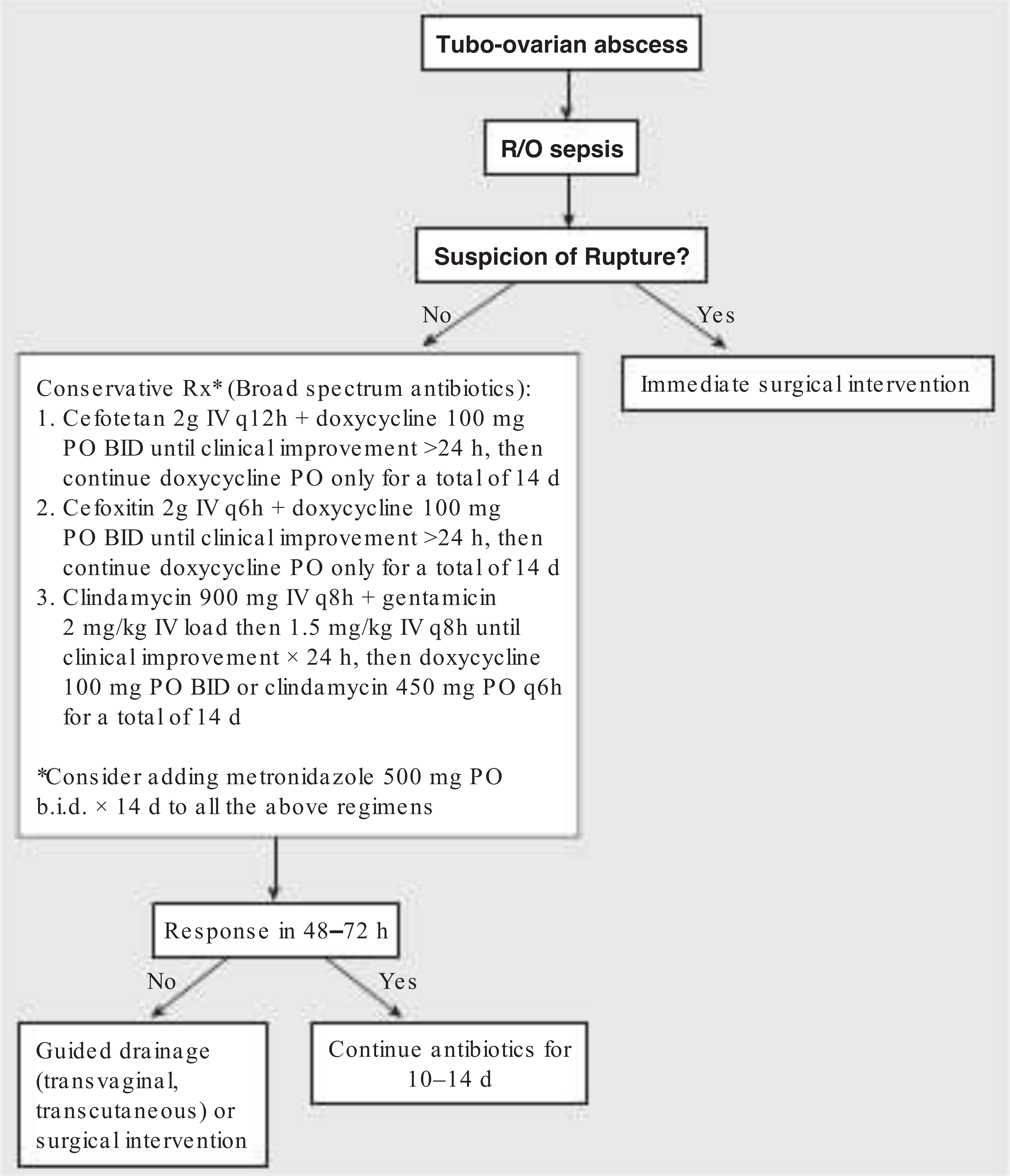
!

- 15% risk of tubal damage after one episode of PID; 35% after two episodes; 75% after three
- Infertility is more common with gonorrhea, and delay of Rx.

!

IUD: the device does not have to be removed during treatment of PID. If the patient prefers removal, it should not be removed until at least 2 doses of antibiotic Rx have been administered.

For approach to the management of tubo-ovarian abscesses, see Figure 10.7.



Conservative Rx* (Broad spectrum antibiotics):
1. Cefotetan 2g IV q12h + doxycycline 100 mg PO BID until clinical improvement >24 h, then continue doxycycline PO only for a total of 14 d
2. Cefoxitin 2g IV q6h + doxycycline 100 mg PO BID until clinical improvement >24 h, then continue doxycycline PO only for a total of 14 d
3. Clindamycin 900 mg IV q8h + gentamicin 2 mg/kg IV load then 1.5 mg/kg IV q8h until clinical improvement × 24 h, then doxycycline 100 mg PO BID or clindamycin 450 mg PO q6h for a total of 14 d

*Consider adding metronidazole 500 mg PO b.i.d. × 14 d to all the above regimens

Response in 48–72 h
No
Yes
Guided drainage (transvaginal, transcutaneous) or surgical intervention
Continue antibiotics for 10–14 d

Figure 10.7. Approach to the management of tubo-ovarian abscesses.

CERVICAL CANCER SCREENING

MCC OBJECTIVE

Based on Objective #74 (Periodic Health Examination [PHE]) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Carcinoma of the cervix is a preventable disease.
- Female patients visiting their 1° care physicians should follow the provincial screening guidelines for cervical CA.
- Up to 90% of cervical CAs are squamous cell carcinomas, and the remainders are adenocarcinomas.
- Rarely, cervical CAs have features of both squamous cell carcinomas and adenocarcinomas (i.e., adenosquamous carcinomas).
- The Pap cytologic test ("Pap test") is the only way to detect abnormal cells on the cervix.
- Cervical CA has a long natural Hx with a long precancerous phase.
- Screening programs ↓ the incidence of invasive disease.
- Only 81% of Ontario women report having had a recent Pap test.

Epidemiology

- Cervical CA is the second most common CA in women < 50 yr.
- The median age at Dx of cervical CA is 47 yr.

CLINICAL box

HPV subtypes

Low risk: **6, 11,** 41, 44

Intermediate risk: 31, 33, 35

High risk: **16, 18,** 45, 56

- The median age at death from cervical CA is 60 yr.
- The 11th most common CA in women and 13th most common CA-related cause of death.
- From 1981 to 2002, the incidence of cervical CA ↓ by approximately 50% in Ontario, due to Pap smear screening.
- Other causes for abnormal Pap smears, other than the HPV virus, are unknown.

CLINICAL box

HPV Transmission

- HPV is transmitted sexually and is the most common STI.
- Condoms do not fully protect against transmission of HPV.
- HPV can be transmitted without penetration.

CLINICAL box

1° Prevention of Cervical CA

- Pap smear: the mainstay of screening for precancerous lesions
- HPV vaccine
- Colposcopy
- Rx of precancerous lesions

CAUSAL CONDITIONS

RFs for Cervical CA

- HPV infection with high-risk subtype
- First intercourse at a young age (early coitarche)
- Multiple sexual partners
- Cigarette smoking
- Multiparity
- Long-term use of OCP (inconclusive evidence)
- Immunocompromised status
- Low socioeconomic status
- High-risk sexual partners (i.e., partners whose previous sexual contacts have developed cancerous or precancerous lesions of the cervix)
- Presence of other STIs

HPV

- HPV is one of the most common STIs.
- 75% of Canadians have had one or more HPV infections.
- 95% of squamous cell carcinomas have HPV oncogenic types as do 60% of cervical adenocarcinomas.
- There are 20 HPV types that have been identified as carcinogenic.
- Types 16 and 18 are found most commonly in malignant lesions.

APPROACH

- Pap smears can be obtained by conventional Pap smear or with liquid-based cytology. Liquid-based cytology is the preferred method for obtaining cervical cytology (Table 10.42).

TABLE 10.42 • Type of cervical Pap smears

Liquid-Based Smear	Traditional Pap Smear
1. Specimen is collected by wiping cells from the cervix and endocervix.	1. A wooden spatula is used to wipe cells from the surface of the cervix.
2. The cells are suspended in liquid to remove blood and mucus. • Decreased unsatisfactory Pap test results, but increased cost. Evidence so far shows equivalent clinical outcomes. • Improved Dx of low and high grades SIL • Can be used to identify HPV subtypes	2. A brush is used to wipe cells from the endocervical canal—(may cause bleeding; should be avoided in pregnancy). 3. These cells are spread onto a slide that is fixed for cytologic exam.

- The liquid-based cytology screen has been found to be more sensitive and is associated with fewer unsatisfactory specimens.
- The transformation zone undergoes transformation from glandular cells to squamous cells (i.e., metaplasia).
- Areas of active metaplasia are the most susceptible site for infection by HPV, and subsequent development of cervical CA.
- See Figure 10.8 for Pap smear descriptive conventions and Table 10.43 for Pap smear report legend. See Figure 10.9 for anatomical diagram of squamocolumnar junction.

Population Screening (Figure 10.10)

- There are slight differences among each province
- Should begin within 3 yr of initiating sexual activity or over age 21, whichever is later
- Should be conducted annually until three consecutive negative Pap tests

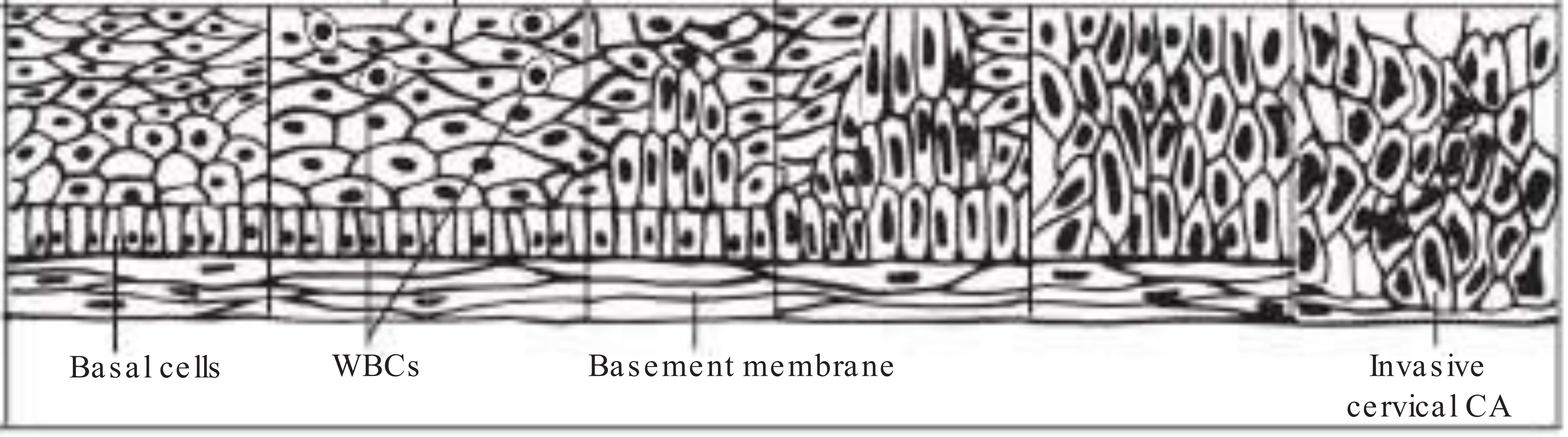
Descriptive convention						
Class system	Class I (normal)	Class II inflammation	Class III Mild dysplasia	or Moderate dysplasia	Class IV Severe dysplasia CIS	Class V suggestive of CA or CIS
CIN system	Normal	Inflammatory	CIN I	or CIN II	CIN III	Suggestive of CA
Bethesda II system	Within normal limits	a. without atypia b. with atypia or cellular changes associated with HPV	LSIL	HSIL	HSIL	Squamous cell CA
Bethesda 2001	Negative for intraepithelial lesion or malignancy	ASCUS ASC-H	LSIL	HSIL		Squamous cell CA
Histology						

Figure 10.8. Pap smear descriptive conventions.

TAbLE 10.43 • Pap smear result possibilities

Unsatisfactory/inadequate sample
Normal
Benign atypia (infection, reactive Ds)
Cervical Intraepithelial Neoplasia (CIN)
Atypical Squamous Cells - Uncertain Significance (ASCUS)
Atypical Squamous Cells - Possible HSIL (ASC-H)
Low-grade Squamous Intraepithelial Lesion (LSIL)
High-grade Squamous Intraepithelial Lesion (HSIL)
Carcinoma in situ (CIS)
Atypical Glandular Cells of Uncertain Significance (AGUS)
Invasive cervical cancer (rarely)

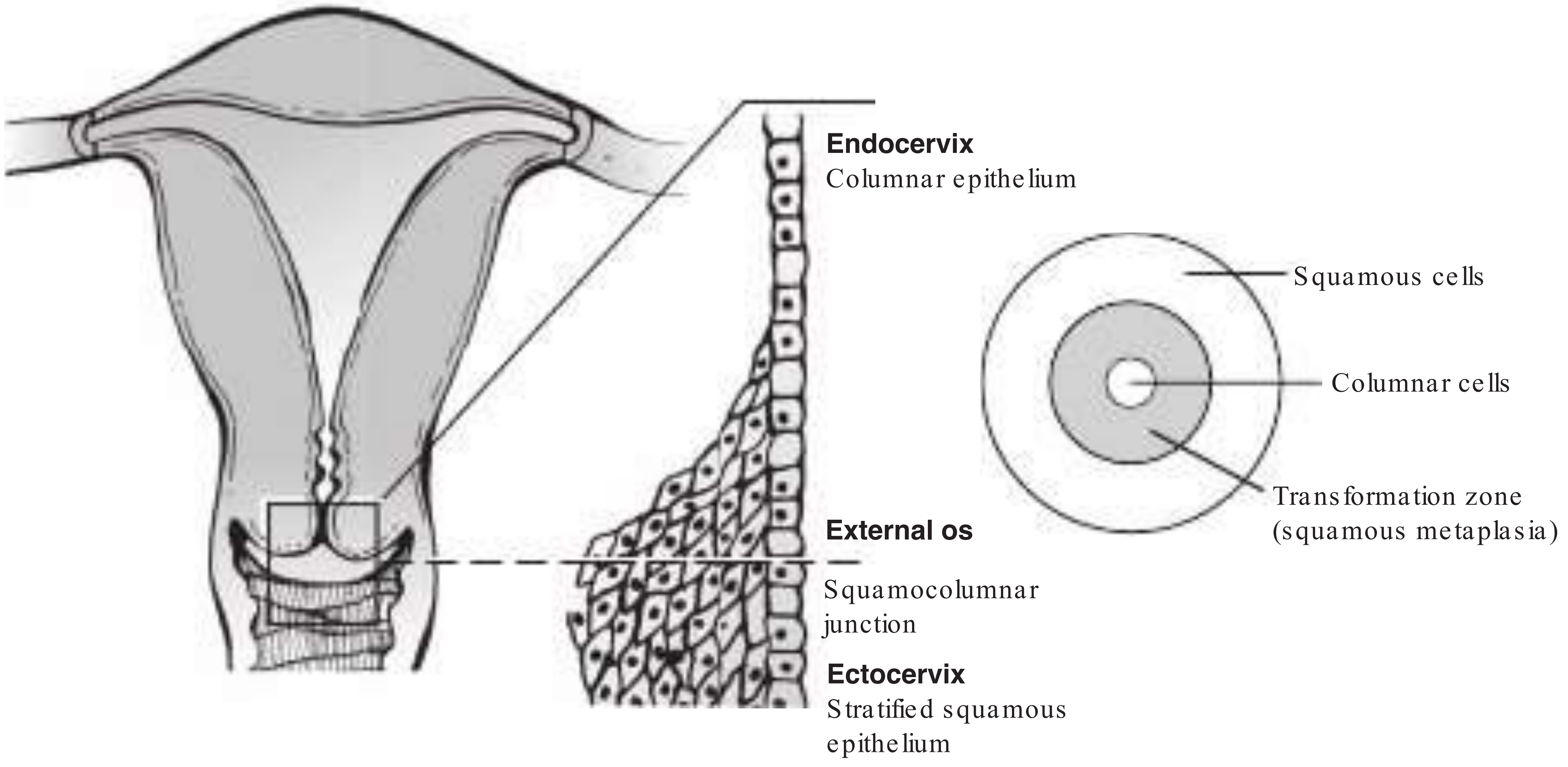


Figure 10.9. The squamocolumnar junction.

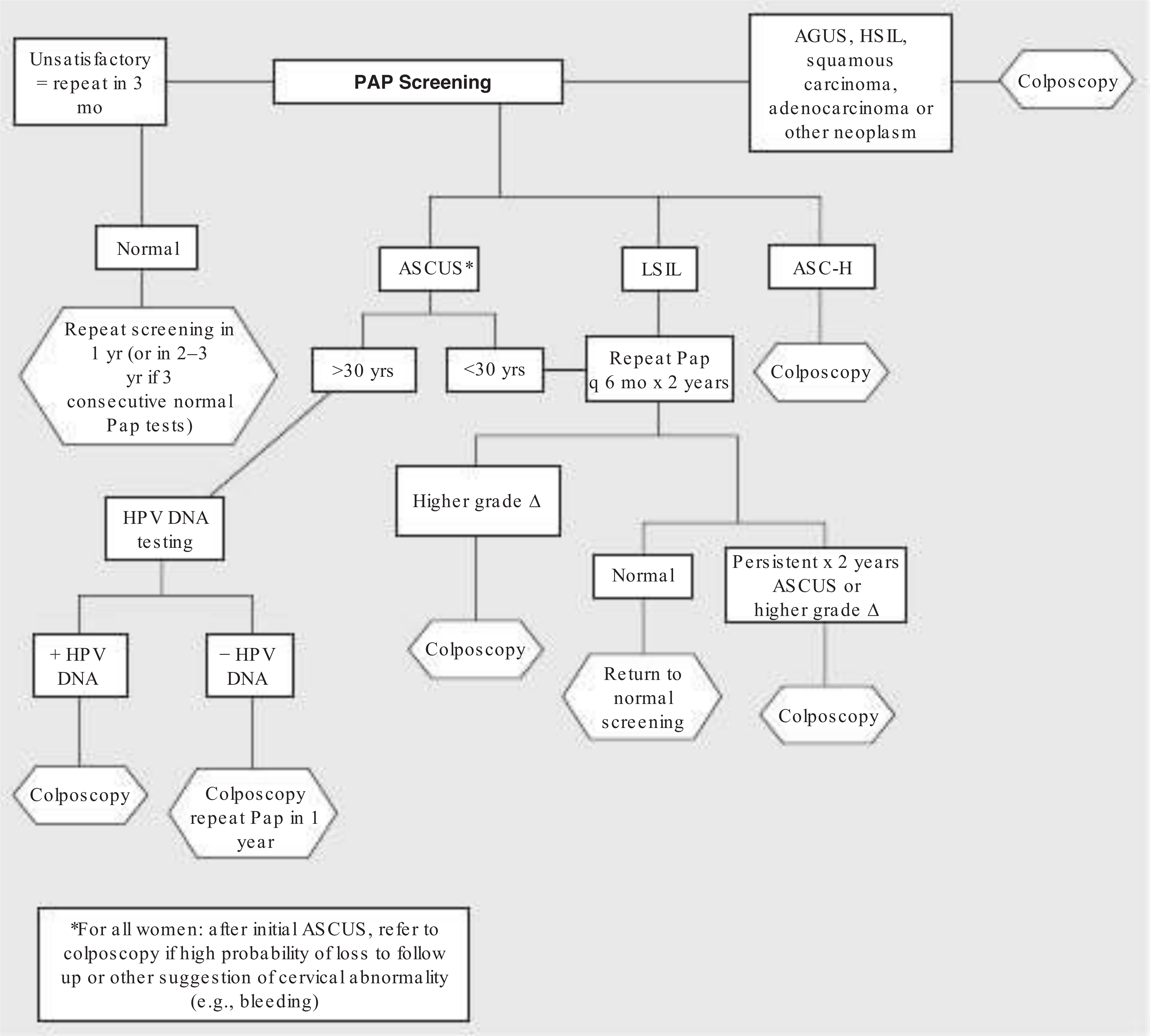

Unsatisfactory = repeat in 3 mo
PAP Screening
AGUS, HSIL, squamous carcinoma, adenocarcinoma or other neoplasm
Colposcopy
Normal
Repeat screening in 1 yr (or in 2–3 yr if 3 consecutive normal Pap tests)
ASCUS*
LSIL
ASC-H
>30 yrs
<30 yrs
Repeat Pap q 6 mo x 2 years
Colposcopy
HPV DNA testing
Higher grade Δ
Normal
Persistent x 2 years ASCUS or higher grade Δ
+ HPV DNA
− HPV DNA
Colposcopy
Return to normal screening
Colposcopy
Colposcopy
Colposcopy repeat Pap in 1 year
*For all women: after initial ASCUS, refer to colposcopy if high probability of loss to follow up or other suggestion of cervical abnormality (e.g., bleeding)

Figure 10.10. Approach to cervical CA screening. These are recommended as minimum guidelines adapted from the Ontario Cervical Cancer screening Guideline 2005. Note: For patients with ASCUS who are > 30 yr → if HPV DNA testing is not available, repeat cytology in 6 mo is recommended × 2 with colposcopy if ASCUS or higher grade Δ. (Adapted from Ontario Cervical Cancer Screening Guideline 2005.)

- If these Pap tests are normal → continue screening q2–3 yr
- Should continue until the age of 69 yr, if there has been adequate screening over the past 10 yr
- If there has been no Pap smear for 5 yr, begin annual Pap tests until three consecutive negative Pap tests, then should continue q2–3 yr
- Discontinue screening at age 70 if > 3 normal Pap tests in the last 10 yr

Screening in Special populations

- Women with HIV/immunocompromised should receive annual screening.
- Discontinue screening for women who have undergone a total hysterectomy for benign reasons and no Hx of cervical dysplasia or HPV.
- Women who have undergone a subtotal hysterectomy (i.e., cervix intact) should continue routine screening.
- Screening frequency in pregnancy is the same as in nonpregnant women.
- Women who have sex with women should follow the same screening protocol as women who have sex with men.

Colposcopy

- Pap smear carries a false-negative rate of 15% to 40% for invasive CAs.
- Colposcopy provides magnification and illumination of the cervix to:
  - Further assess abnormalities on the cervix
    - Confirm Dx by biopsy
  - R/O invasive disease
  - F/U after Rx

Procedure

Magnification to first inspect the transformation zone visually, then after application of 3% to 5% acetic acid, then Lugol solution

- Biopsies are performed of abnormal-appearing epithelium.
- Colposcopically directed biopsies carry an accuracy of 85% to 95%.
- Endocervical curettage can be performed to R/O dysplasia within the cervical canal.

HPV Vaccine (e.g., Gardasil)

- The quadrivalent HPV vaccine protects against HPV types 6, 11, 16, and 18. It is given at zero, 2 mo, and 6 mo intervals.
- It is most effective when given before the onset of sexual activity.
- National Advisory Committee on Immunization (NACI) recommends immunization (2015 updated schedule):
  - For the prevention of cervical CA, adenocarcinoma *in situ* (AIS), vulvar, vaginal, anal CAs and their precursors, and anogenital warts:
  - Females 9 through 26 yr of age
  - For the prevention of anal intraepithelial neoplasia, anal CA, and anogenital warts:
  - Males between 9 and 26 yr of age
  - May be administered to females or males over 26 yr of age
  - Not recommended < 9 yr of age as no immunogenicity or efficacy data are available in these groups
- This position is supported by the interim statement of the SOGC on HPV immunization as well as the American Cancer Society.
- Women who receive the vaccine should continue to get screened regularly for cervical CA since they may still be exposed to or infected with other types of HPV.

Cervical CA (Table 10.44 for Staging and Rx)

- Peak incidence for cervical CA begins at 45 yr.

TABLE 10.44 • Staging and Rx of cervical CA

Stage	Description	Rx
0	CIS, preinvasive carcinoma No stromal invasion	Localized Rx: cryotherapy, LEEP, laser Rx, or conization
I	Invasive carcinoma confined to the cervix	Conization or radical hysterectomy ± radiation (Depending on lesion size and patient preference)
II	Extends beyond the cervix but not onto the pelvic wall ± upper 2/3 of vagina	Radiotherapy ± concurrent chemotherapy
III	Extends to the pelvic wall or involves the lower 1/3 of the vagina	Radiotherapy ± concurrent chemotherapy
IV	Extends beyond true pelvis, or has clinically involved the mucosa of the bladder or rectum	Radiotherapy ± concurrent chemotherapy

CLINICAL box

Signs and Sx of Cervical CA

- Postcoital/irregular bleeding
- Malodorous, bloody discharge
- Leg edema (advanced disease)
- Deep pelvic pain (advanced disease)
- Sciatica (advanced disease)

- Long precancerous phase with 3 to 5 yr to progress from one grade of dysplasia to the next.
- From the detection of cytologic abnormalities to invasive CA takes 15 to 20 yr.
- Invasive carcinoma of the cervix is usually preceded by a spectrum of preinvasive disease, which can be detected by a Pap smear. It usually takes up to 10 yr for abnormal cells to turn into CA.

PELVIC MASSES

MCC OBJECTIVE

Based on Objective #2 (Abdominal/Pelvic Mass) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Pelvic masses are common and can be found in females at any age (fetal to postmenopausal).
- All pelvic masses should be investigated and diagnosed because early detection may affect outcome.

CAUSAL CONDITIONS

Pelvic masses may originate from gynecologic organs (ovary, fallopian tube, cervix, or uterus) or from other nongynecologic pelvic organs (bowel, bladder, ureters, skeletal muscle, or bone) (Table 10.45).

APPROACH (Figure 10.11)

The key objectives when investigating a woman with a pelvic mass are determination of:

- Their pregnancy status (b-hCG testing)
- Whether the mass is gynecologic versus nongynecologic

TAbLE 10.45 • DDx of pelvic mass

Age Group	DDx			
	Gynecologic			Nongynecologic
	Ovary	Fallopian Tube	Uterus	
prepubertal	1. Benign simple ovarian cysts (i.e., germinal inclusion cyst, paraovarian cyst) 2. Dermoid cysts (benign cystic teratoma)[a] 3. Malignant germ cell tumors • Dysgerminoma • Yolk sac/endodermal sinus tumors • Embryonal carcinoma[a] • Granulosa cell/Sertoli-Leydig[a] 4. Gonadoblastomas (rare)	1. Peritubular cyst 2. Congenital cysts • Mesonephric • Paramesonephric	1. Uterine anomaly (bicornuate uterus, uterus didelphys)	1. Pelvic kidney 2. Distended bladder 3. Appendiceal abscess
Reproductive	1. Functional ovarian cysts (follicular, corpus luteum, thecal lutein, hemorrhagic) 2. Polycystic ovaries 3. Endometrioma 4. Luteoma of pregnancy 5. Benign neoplasm (such as dermoid or fibroma) 6. Borderline epithelial ovarian tumors 7. Malignant epithelial and germ cell tumors • Serous • Mucinous • Endometrioid • Clear cell • Teratoma (solid/cystic) • Choriocarcinomaa • Polyembryonic CA[a] • Endodermal sinus/yolk sac (rare) • Granulosa cell /Sertoli-Leydig[a]	1. Ectopic pregnancy 2. Tubo-ovarian abscess 3. Hydrosalpinx/ pyosalpinx 4. Embryologic remnant cysts • Mesonephric • Paramesonephric 5. 1° fallopian tube neoplasm	1. Pregnancy 2. Adenomyoma 3. Leiomyoma (fibroid) 4. Hematometra/ pyometra 5. Endometrial CA (rare) 6. Leiomyosarcoma (rare)	1. Distended bladder 2. Appendiceal abscess 3. Diverticular disease 4. Pelvic kidney 5. Redundant sigmoid colon 6. 1° CA (rectal, colon, or bladder) 7. Metastatic CA (breast, colon, lung)
Peri/ postmenopause (malignancy until proven otherwise)	**Malignant neoplasms** 1. Epithelial cell tumors • Cystadenocarcinomas (serous or mucinous) • Endometrioid • Clear cell 2. Sex cord neoplasms • Granulosa cell tumor[a] • Sertoli-Leydig cell tumor[a] 3. Metastases (i.e., Krukenberg tumor from GI CA) **benign neoplasms** (rare)—thecoma or fibromas	1. Tubo-ovarian abscess 2. Hydrosalpinx/ pyosalpinx 3. Embryologic remnant cysts • Mesonephric • Paramesonephric 4. 1° fallopian tube neoplasm	1. Endometrial CA 2. Leiomyosarcoma (rare) 3. Adenomyoma 4. Leiomyoma (fibroid) 5. Hematometra/ pyometra	1. Distended bladder 2. Appendiceal abscess 3. Diverticular disease 4. Pelvic kidney 5. Redundant sigmoid colon 6. 1° CA (rectal, colon, or bladder) 7. Metastatic CA (breast, colon, lung)

[a] **Hormonally active** (can secrete hormones).

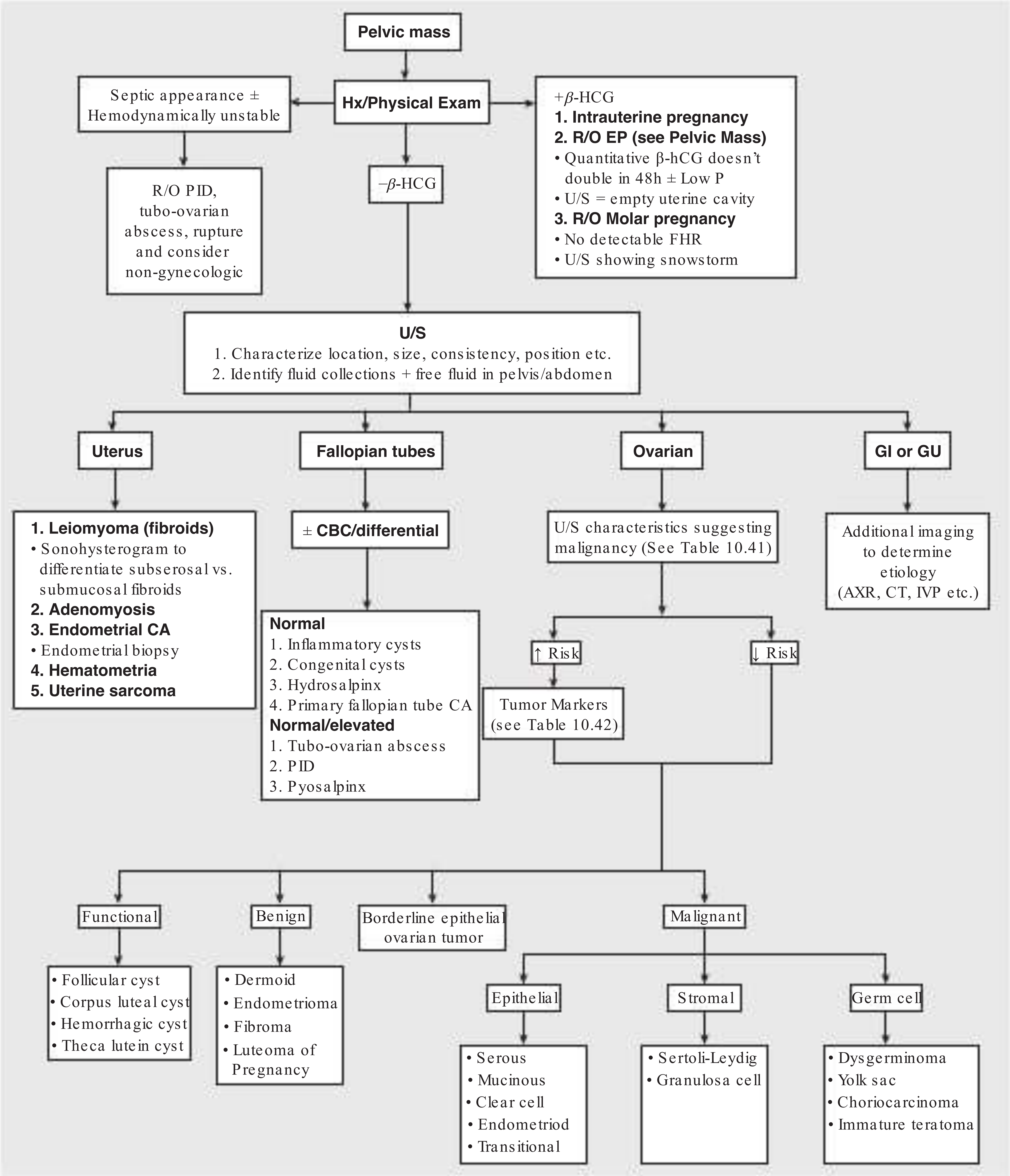


Figure 10.11. Approach to the Dx of pelvic mass.

- The anatomic location of the mass (fallopian tube, ovary [Figure 10.12], or uterus [Figure 10.13])
- The characteristics (consistency, size, shape, mobility, etc.) of the mass

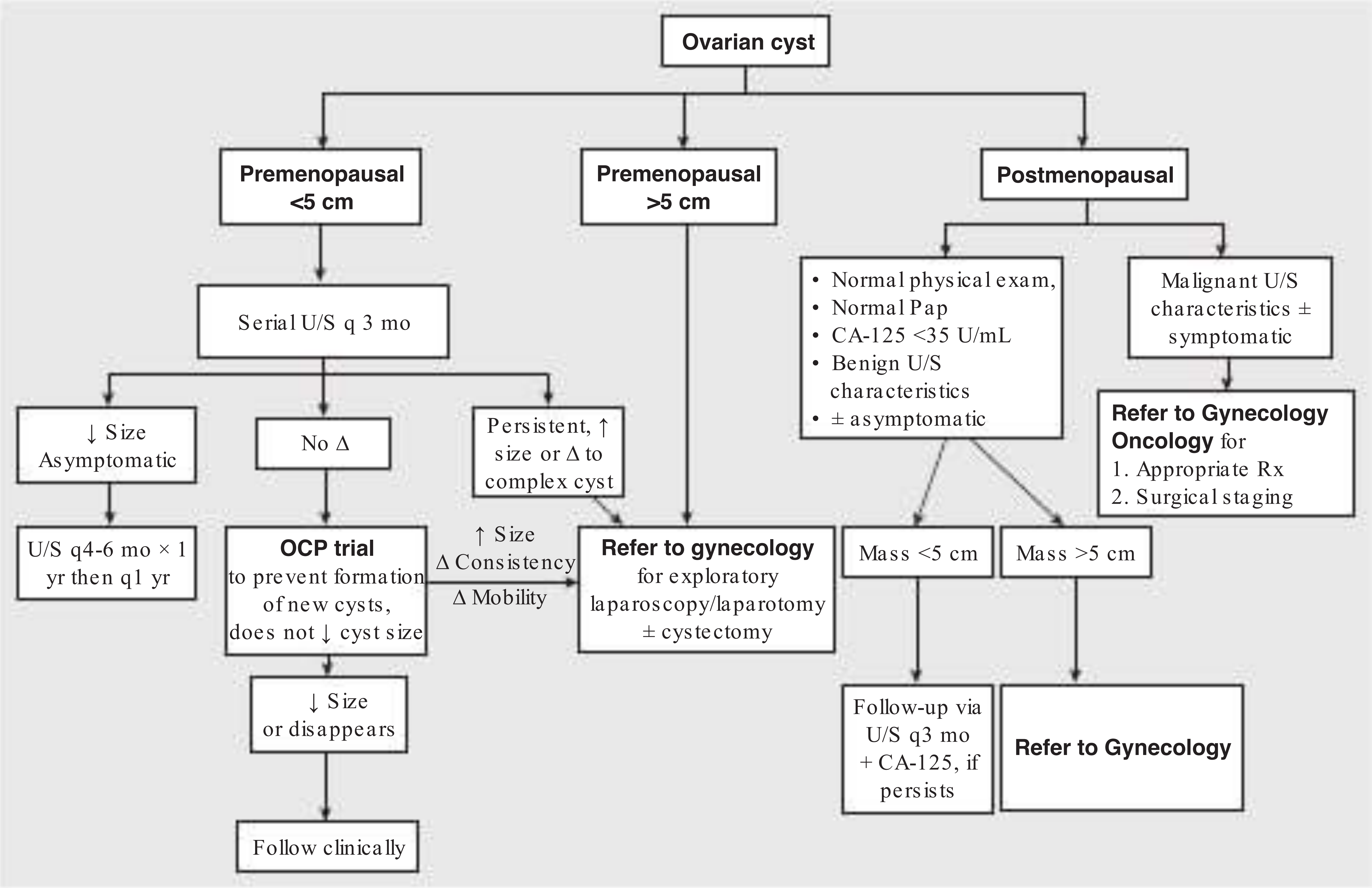

Ovarian cyst
Premenopausal <5 cm
Premenopausal >5 cm
Postmenopausal
Serial U/S q 3 mo
↓ Size Asymptomatic
No Δ
Persistent, ↑ size or Δ to complex cyst
U/S q4-6 mo × 1 yr then q1 yr
OCP trial to prevent formation of new cysts, does not ↓ cyst size
↑ Size
Δ Consistency
Δ Mobility
Refer to gynecology for exploratory laparoscopy/laparotomy ± cystectomy
↓ Size or disappears
Follow clinically
• Normal physical exam,
• Normal Pap
• CA-125 <35 U/mL
• Benign U/S characteristics
• ± asymptomatic
Malignant U/S characteristics ± symptomatic
Refer to Gynecology Oncology for
1. Appropriate Rx
2. Surgical staging
Mass <5 cm
Mass >5 cm
Follow-up via U/S q3 mo + CA-125, if persists
Refer to Gynecology

Figure 10.12. Approach to the management of ovarian cysts.

History

- See Table 10.46

CLINICAL box

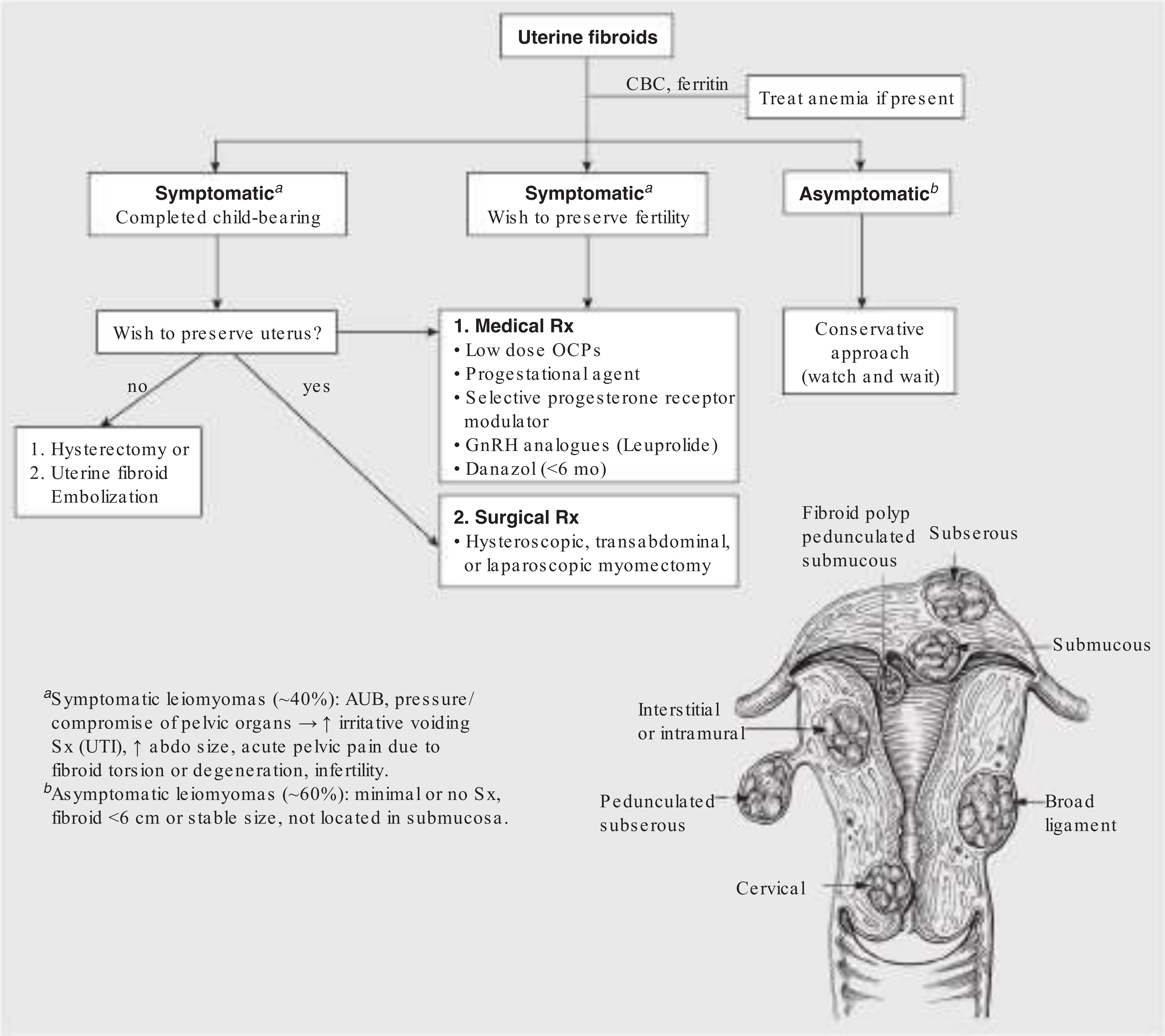
Features Characteristic of Exposure to ä Sex Hormone levels

Features of Androgenization

- Prepubertal age:
  - Clitoromegaly (> 5 mm wide)
  - Hirsutism
- Reproductive age:
  - Hirsutism
  - Acne and/or seborrhea
  - Alopecia
  - Deepening of voice
  - ↑ Muscle bulk

Features of Estrogenization

- Prepubertal age:
  - Premature menarche
  - Precocious puberty (advanced Tanner staging)


Uterine fibroids
CBC, ferritin
Treat anemia if present
Symptomatic[a] Completed child-bearing
Symptomatic[a] Wish to preserve fertility
Asymptomatic[b]
Wish to preserve uterus?
no
yes
1. Hysterectomy or
2. Uterine fibroid Embolization
1. Medical Rx
• Low dose OCPs
• Progestational agent
• Selective progesterone receptor modulator
• GnRH analogues (Leuprolide)
• Danazol (<6 mo)
2. Surgical Rx
• Hysteroscopic, transabdominal, or laparoscopic myomectomy
Conservative approach (watch and wait)
Fibroid polyp pedunculated submucous
Subserous
Submucous
Interstitial or intramural
Pedunculated subserous
Broad ligament
Cervical

[a] Symptomatic leiomyomas (~40%): AUB, pressure/compromise of pelvic organs → ↑ irritative voiding Sx (UTI), ↑ abdo size, acute pelvic pain due to fibroid torsion or degeneration, infertility.

[b] Asymptomatic leiomyomas (~60%): minimal or no Sx, fibroid <6 cm or stable size, not located in submucosa.

Figure 10.13. Approach to the management of uterine leiomyomas.

TAbLE 10.46 • Pelvic mass—focused Hx

HPI and Hx	Menstrual Hx	Sexual Hx	OB/GYN Hx
• Characterize any abdo/pelvic pain (OPQRST) • Bloating or early satiety • Review of Sx • Weight D, energy level • Skin/hair D • Acne/hirsutism • Breast discharge/pain • Urinary/bowel patterns • Constitutional Sx • GI: early satiety • Abdo fullness • Medications • Pastsurgical Hx • FHx or personal Hx of breast, ovarian, GI, endometrial CA	• Menarche • Cycle length • Flow duration + heaviness • D in menstrual pattern • AUB • PMS • Menstrual pain	• # Partners • Method(s) of contraception • Dyspareunia	• Hx STIs, vaginitis • Hx vaginal discharge • Pap smear status • GTPAL status • Mode of delivery • Hx pregnancy complications

CLINICAL box

Lab Markers in Dx of the Pelvic Mass

Play a role in:

1. Adding to the clinical suspicion of malignancy
2. F/U with respect to Rx and recurrence of disease

CLINICAL box

Diagnostic Imaging of Pelvic Masses

1. U/S
   - First choice
   - Delineates mass qualities (cystic vs. solid, size, location)
   - Assesses for ascites
   - Safe in pregnancy
2. CT
   - Suboptimal for assessing the ovary
   - Assesses all other organs, lymph nodes
   - Assesses retroperitoneum
3. MRI
   - Identification of soft tissue lesions
   - Safe in pregnancy
4. Other
   - Abdo XR
   - IV pyelogram

Physical Exam (Tables 10.47 and 10.48)

TABLE 10.47 • Pelvic mass—focused physical exam

Breasts	• Tanner staging • Tenderness • Masses • Discharge
Abdo	• Masses or organomegaly • Tenderness, guarding, rebound • Ascites
Pelvic ± bimanual exam	• **External:** clitoromegaly (> 5 mm wide), Tanner staging • **Speculum**: vagina (color, odor, physiologic leukorrhea, rugae, discharge), cervix (discharge, color, abnormalities) • **Bimanual:** ◦ Cervix (motion tenderness) ◦ Uterus (position, size, shape, mobility, symmetry, tenderness, consistency) ◦ Adnexa (size, shape, mobility, tenderness, consistency, location of mass)
Other	• Assess lymph nodes (cervical, supraclavicular, and inguinal) • DRE • Rectovaginal exam (assess posterior uterine surface, uterosacral ligaments, parametria, pouch of Douglas, and rectum)

TABLE 10.48 • U/S characteristics of benign versus malignant ovarian masses

Characteristics	Benign	Malignant
Patient age	Reproductive age	Prepubertal, perimenopausal, postmenopausal
Location	Unilateral	Bilateral
Size	< 5 cm	> 10 cm or > 5 cm initially but rapid ↑ (i.e., < 6 wk)
Consistency	Cystic	Solid or mixed Multiple and/or thick septae
Shape	Smooth	Irregular Papillary projections
Mobility	Movable	Fixed
Other	± Small amount of physiologic free fluid	↑ Volume of free fluid in pelvis or abdo (ascites) Increased vascularity

Investigations (Table 10.49)

Management

- Depends on the age of patient, size of the mass, U/S features, and tumor markers.
- Must take into consideration the patient's age, desire to preserve fertility, and patient preference.
- Any ovarian mass in a postmenopausal woman is considered CA until proven otherwise.
- Any solid ovarian mass in childhood is considered malignant until proven otherwise.

Indications for Specialty Referral with Pelvic Mass

- Persistent masses (> 2 menstrual cycles) in reproductive-aged women
- Any postmenopausal mass

TABLE 10.49 • Investigation of pelvic mass—lab markers for ovarian masses

Tumor Marker	Source	Normal Value	ää Levels Found in	Sensitivity
CA-125 Sensitivity > > specificity[a]	Glycoprotein produced by fetal coelomic epithelium	< 35 U/mL	• Epithelial cell ovarian tumors • Also elevated in: fibroids, PID endometriosis, cirrhosis, adenomyosis, pregnancy, appendicitis breast/lung/ovarian/colon/fallopian tube CAs, pancreatitis, renal failure, ascites	• ↑ In ~85% of ovarian CAs • ↑ In ~50% of stage I ovarian CAs • If postmenopausal with complex adnexal mass and Ca-125 > 200, 96% PPV for ovarian CA • Testing for CA-125 in premenopausal women not diagnostic on its own because of ↑ # benign causes of its elevation
AFP[a]	Major protein in fetal serum; **not** detectable after birth	< 5.4 ng/mL	• Germ cell tumors (i.e., endodermal sinus) • Also dermoids, pregnancy, HCC	• ↑ In ~85% of germ cell tumors • ↑ In ~20% of stage I germ cell tumors
LDH[a]	Enzyme found in almost all body tissues	< 250 U/L	Dysgerminomas	
hCG[a]	Normally produced by the placenta	< 5 mIU/mL	• Germ cell tumors GTD (i.e., choriocarcinoma) • Also in pregnancy, marijuana use	• ↑ In ~80% of germ cell tumors • ↑ In ~20% of stage I germ cell

[a] Not effective screening tool(s) for ovarian CA.

- Any mass with one or more of the following (regardless of if patient is asymptomatic):
  - > 5 cm with growth
  - Nodular, fixed, solid
  - Presence of ascites
  - ↑ CA-125
  - Suspected abnormal pregnancy, malignancy, and masses requiring surgical intervention

CLINICAL box

Ovarian Carcinoma—Epithelial Cell Tumors

Epidemiology

- Approximately 80% of ovarian CAs
- Lifetime incidence 1.5%

RFs

- FHx of ovarian CA (5% if one first-degree relative affected; 7% if two)
- Excess ovulation (low parity, nulliparity, early menarche, late menopause)
- Increasing age
- Lynch II syndrome: familial disposition to endometrial, ovarian, and GU CAs
- Mutations in *BRCA1* (chr17q) and *BRCA2* (chr13q) tumor suppressor genes which account for familial breast ovarian CA

Protective Factors

- OCP use
- Lactation
- Tubal ligation or salpingectomy

Screening

No reliable screening test available

Dx

Surgical staging

Rx

- Surgical debulking, chemotherapy. Follow progress with serum CA-125 levels. If carrier of *BRCA1* or *BRAC2* can recommend prophylactic bilateral salpingectomy ± oophorectomy when childbearing is complete.

PELVIC PAIN

MCC OBJECTIVE

Based on Objective #73 (Pelvic Pain) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Acute pelvic pain: lasting < 6 mo
- Chronic pelvic pain (CPP) is one of the most common problems in gynecology. It is characterized by:
  - Pain located below the umbilicus and in the pelvis
  - Pelvic pain lasting > 6 mo
  - Pain severe enough to interfere with quality of life or daily functioning and may require medical and/or surgical intervention(s)
- Women average approximately 2 to 3 visits/yr to physicians' offices with CPP. Only one-third of these women are given a specific Dx. The absence of a clear Dx can frustrate both patients and clinicians.

Acute pelvic pain is potentially life threatening.

TABLE 10.50 • DDx of pelvic pain

Condition	Acute	Chronic/Recurrent
Gyne	Pregnancy-related: • EP • Aborting pregnancy • Labor/PTL • Abruptio placenta • Molar pregnancy Nonpregnancy related: • PID ± adhesions • Ovarian mass/cyst complications (torsion, hemorrhage, rupture) • Degenerating fibroids • Ovulation pain	• Endometriosis • Chronic PID • Adenomyosis • Leiomyomata • Dysmenorrhea • Pelvic adhesions • Vulvar vestibulitis • Vulvodynia • Residual ovarian syndrome • Chronic pelvic infection (TB)
GI	• Acute appendicitis • Diverticulitis • Irritable bowel • IBD	• Irritable bowel • IBD • Diverticulitis • Constipation • Hernia • Neoplastic lesions
Urologic	• UTI • Renal calculi	• Chronic UTIs • Interstitial cystitis • Urethral disorders • Bladder neoplasm
MSK	• Levator ani syndrome • Disc disease • Hernia	• Fibromyalgia • Nerve entrapment syndromes • Mechanical low back pain • Disc disease

Systemic	• Sleep disturbance
	• Mental health issues:
	  • Depression, somatization
	  • Abuse (sexual, physical, and/or psychological)
	  • Domestic violence
	  • Substance abuse	

CLINICAL box

Mental Health Issues and CPP

1. Approximately 25% of patients with CPP have a PMHx of sexual/physical abuse.
2. Depression often coexists with CPP (25%–50%). It is a predictor of:
   - Pain severity
   - Response to Rx

CAUSAL CONDITIONS

In addition to condition, the etiology of pelvic pain can also be classified according to its duration because whether the pain is acute or chronic will affect how it is managed (Table 10.50).

APPROACH (Figure 10.14)

- Hemodynamic status: vitals (BP, HR), general appearance

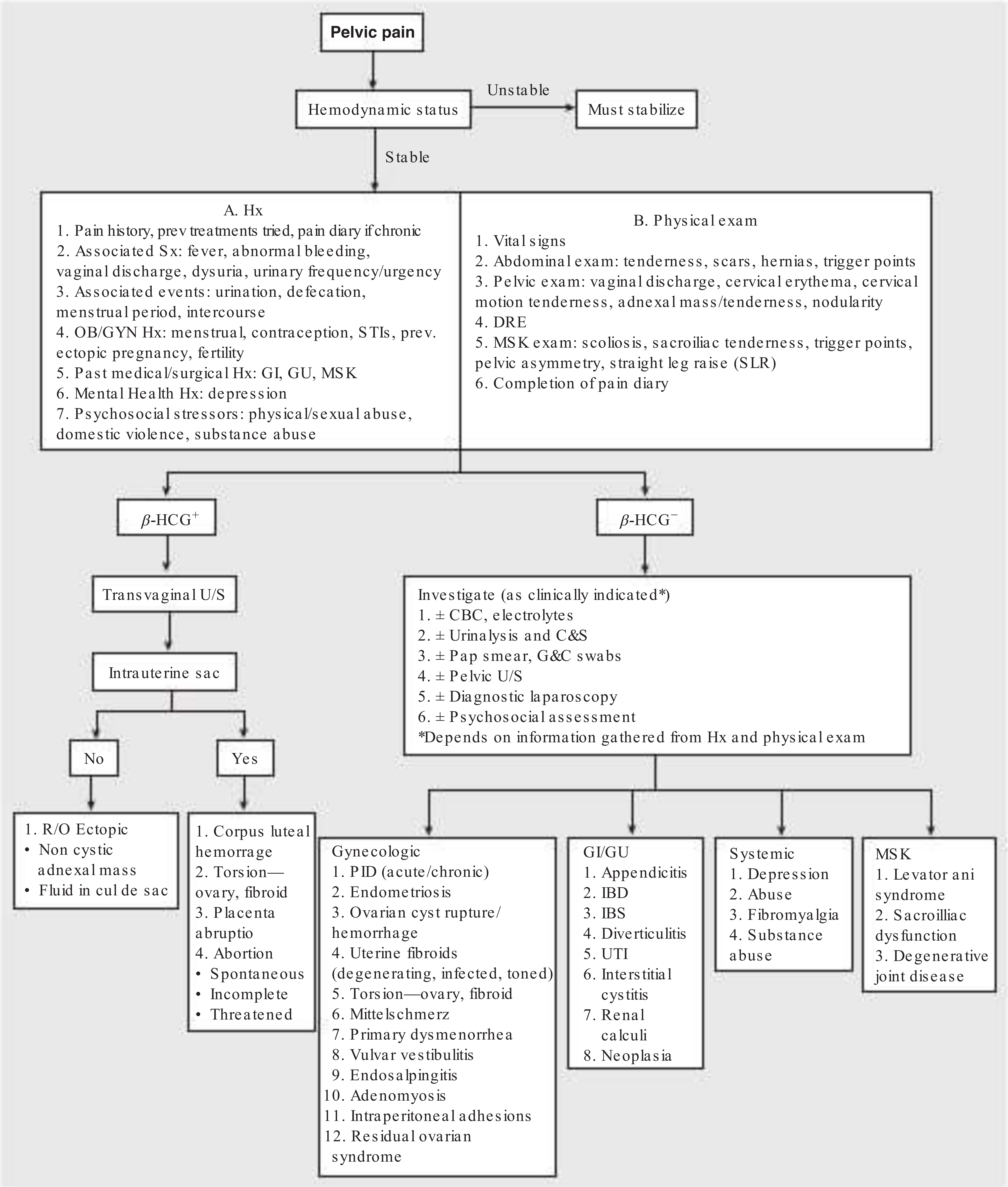

Pelvic pain
Hemodynamic status
Unstable
Must stabilize
Stable
A. Hx
1. Pain history, prev treatments tried, pain diary if chronic
2. Associated Sx: fever, abnormal bleeding, vaginal discharge, dysuria, urinary frequency/urgency
3. Associated events: urination, defecation, menstrual period, intercourse
4. OB/GYN Hx: menstrual, contraception, STIs, prev. ectopic pregnancy, fertility
5. Past medical/surgical Hx: GI, GU, MSK
6. Mental Health Hx: depression
7. Psychosocial stressors: physical/sexual abuse, domestic violence, substance abuse
B. Physical exam
1. Vital signs
2. Abdominal exam: tenderness, scars, hernias, trigger points
3. Pelvic exam: vaginal discharge, cervical erythema, cervical motion tenderness, adnexal mass/tenderness, nodularity
4. DRE
5. MSK exam: scoliosis, sacroiliac tenderness, trigger points, pelvic asymmetry, straight leg raise (SLR)
6. Completion of pain diary
β-HCG$^+$
β-HCG$^-$
Transvaginal U/S
Intrauterine sac
No
Yes
1. R/O Ectopic
• Non cystic adnexal mass
• Fluid in cul de sac
1. Corpus luteal hemorrage
2. Torsion—ovary, fibroid
3. Placenta abruptio
4. Abortion
• Spontaneous
• Incomplete
• Threatened
Investigate (as clinically indicated*)
1. ± CBC, electrolytes
2. ± Urinalysis and C&S
3. ± Pap smear, G&C swabs
4. ± Pelvic U/S
5. ± Diagnostic laparoscopy
6. ± Psychosocial assessment
*Depends on information gathered from Hx and physical exam
Gynecologic
1. PID (acute/chronic)
2. Endometriosis
3. Ovarian cyst rupture/hemorrhage
4. Uterine fibroids (degenerating, infected, toned)
5. Torsion—ovary, fibroid
6. Mittelschmerz
7. Primary dysmenorrhea
8. Vulvar vestibulitis
9. Endosalpingitis
10. Adenomyosis
11. Intraperitoneal adhesions
12. Residual ovarian syndrome
GI/GU
1. Appendicitis
2. IBD
3. IBS
4. Diverticulitis
5. UTI
6. Interstitial cystitis
7. Renal calculi
8. Neoplasia
Systemic
1. Depression
2. Abuse
3. Fibromyalgia
4. Substance abuse
MSK
1. Levator ani syndrome
2. Sacroilliac dysfunction
3. Degenerative joint disease

Figure 10.14. Approach to the Dx of pelvic pain.

- Pregnancy status (b-hCG) plus CBC, coagulation profile—if clinically indicated
- Whether the pain is acute versus chronic. (If acute pelvic pain, may need to stabilize the patient; if chronic pain, may need to proactively schedule time for complete evaluation and counseling of the patient)

Management of Cpp (Figure 10.15)

- Must take into consideration the patients' age, desire to preserve fertility, patient preference, and surgical feasibility.
- Goals of CPP Rx must be realistic and should be focused on:
  - Minimizing disability/restoration of normal function
  - Improving quality of life
  - Preventing relapse
- CPP Rx should be tailored for the individual patient and often requires simultaneous pharmacologic, psychological, and PT.
- A good relationship between the physician and the patient is essential.

CLINICAL box

laparoscopy and CPP

Role in CPP

- Confirmation of Dx
- Surgical intervention
- Rx
- Patient reassurance

Indications

- Persistent CPP with no discernable cause after appropriate investigations
- CPP refractory to pharmacologic Rx

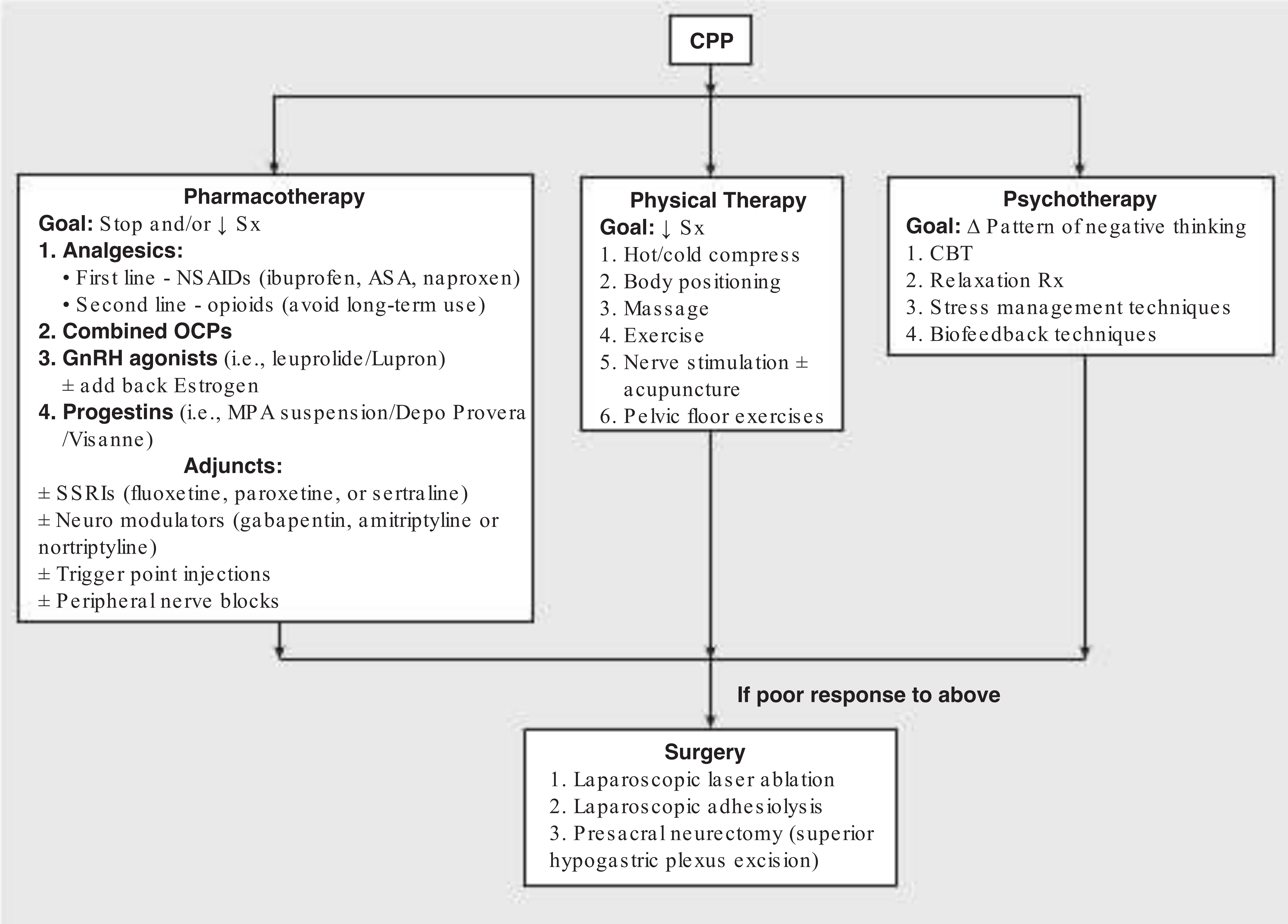

CPP
Pharmacotherapy
Goal: Stop and/or ↓ Sx
1. Analgesics:
• First line - NSAIDs (ibuprofen, ASA, naproxen)
• Second line - opioids (avoid long-term use)
2. Combined OCPs
3. GnRH agonists (i.e., leuprolide/Lupron) ± add back Estrogen
4. Progestins (i.e., MPA suspension/Depo Provera /Visanne)
Adjuncts:
± SSRIs (fluoxetine, paroxetine, or sertraline)
± Neuro modulators (gabapentin, amitriptyline or nortriptyline)
± Trigger point injections
± Peripheral nerve blocks
Physical Therapy
Goal: ↓ Sx
1. Hot/cold compress
2. Body positioning
3. Massage
4. Exercise
5. Nerve stimulation ± acupuncture
6. Pelvic floor exercises
Psychotherapy
Goal: Δ Pattern of negative thinking
1. CBT
2. Relaxation Rx
3. Stress management techniques
4. Biofeedback techniques
If poor response to above
Surgery
1. Laparoscopic laser ablation
2. Laparoscopic adhesiolysis
3. Presacral neurectomy (superior hypogastric plexus excision)

Figure 10.15. Approach to the management of CPP.

CLINICAL box

Common Locations of Ep

1. Ampullary: 70%
2. Isthmic: 12%
3. Fimbrial: 11%
4. Ovarian: 3%
5. Others: interstitial/cornual—2%, Abdo—1%, cervical—< 1%

Ectopic Pregnancy (Figure 10.16 and Table 10.51)

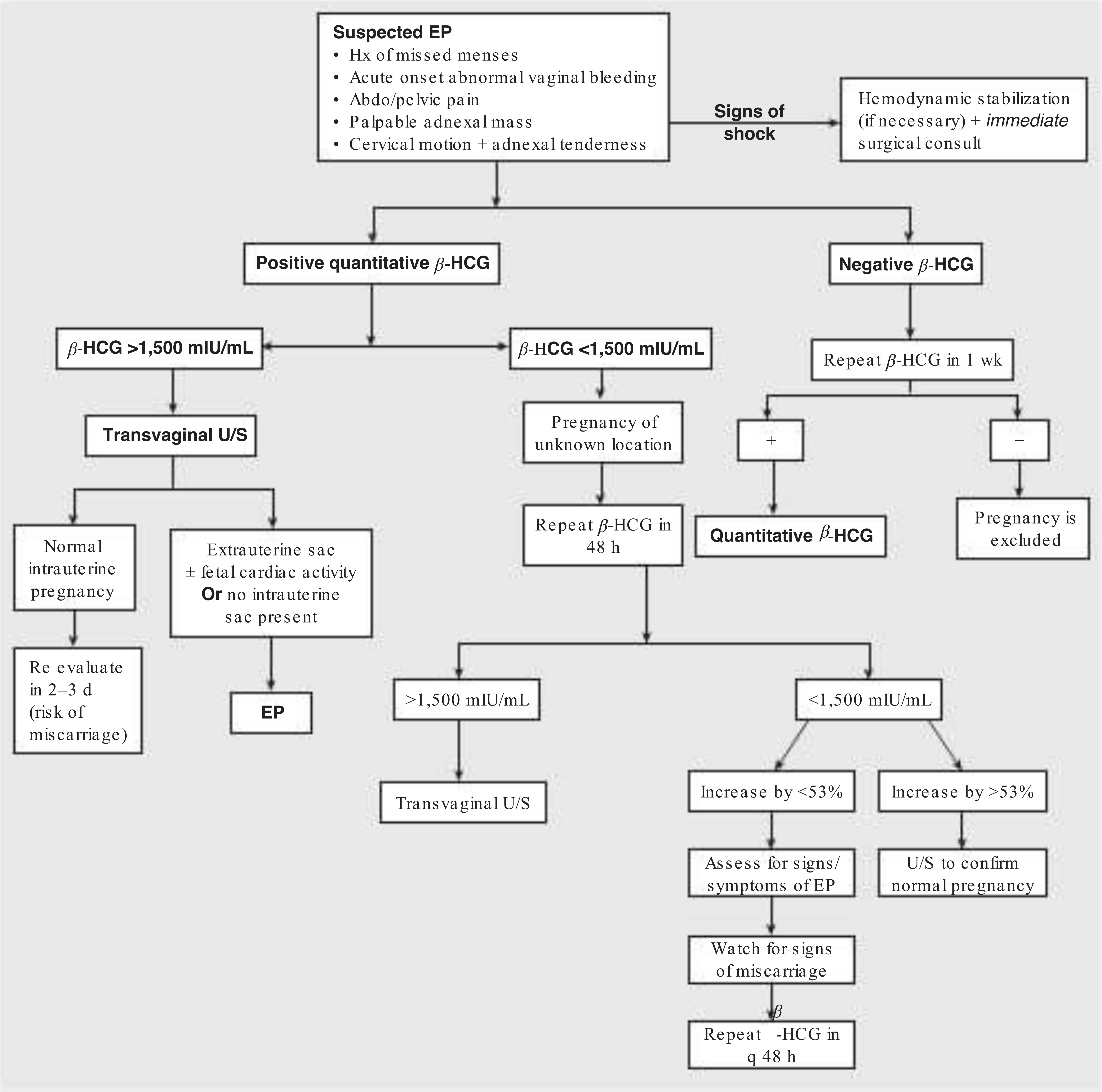

Suspected EP
• Hx of missed menses
• Acute onset abnormal vaginal bleeding
• Abdo/pelvic pain
• Palpable adnexal mass
• Cervical motion + adnexal tenderness
Signs of shock
Hemodynamic stabilization (if necessary) + *immediate* surgical consult
Positive quantitative β-HCG
Negative β-HCG
β-HCG >1,500 mIU/mL
β-HCG <1,500 mIU/mL
Repeat β-HCG in 1 wk
Transvaginal U/S
Pregnancy of unknown location
+
–
Normal intrauterine pregnancy
Extrauterine sac ± fetal cardiac activity Or no intrauterine sac present
Repeat β-HCG in 48 h
Quantitative β-HCG
Pregnancy is excluded
Re evaluate in 2–3 d (risk of miscarriage)
EP
>1,500 mIU/mL
<1,500 mIU/mL
Transvaginal U/S
Increase by <53%
Increase by >53%
Assess for signs/ symptoms of EP
U/S to confirm normal pregnancy
Watch for signs of miscarriage
Repeat β-HCG in q 48 h

Figure 10.16. Approach to the EP.

CLINICAL box

Ectopic pregnancy Risk factors

- Previous EP
- Current IUD
- Hx of PID
- Prev. tubal surgery
- *In utero* DES exposure
- Infertility
- Current smoking
- Uterine structure: fibroids, adhesions, abnormal shape, etc.

TAbLE 10.51 • Management of EP[a]

Methotrexate (MTX)	• Folic acid antagonist that inhibits DNA synthesis and cell reproduction • 86%–94% success rate for Rx of EP • **Criteria:** 1. Hemodynamically stable 2. No active bleeding or signs of hemoperitoneum 3. < 3.5 cm unruptured mass 4. No fetal heart activity 5. b-hCG < 5,000 6. Patient desires future fertility 7. Patient is compliant and able to return for F/U care 8. No CI to MTX • **CI** 1. Breast-feeding 2. Chronic liver disease (alcoholism, fatty liver, etc.) 3. Known sensitivity to MTX 4. Blood dyscrasias (i.e., thrombocytopenia, significant anemia) 5. Hepatic, renal, or hematologic dysfunction • **Dosing:** single IM dose (50 mg/m^2 body surface area) (88.1% success rate); may require a second IM dose • **Monitoring:** serial (weekly) b-hCG levels until undetectable
Laparoscopic surgery **or** laparotomy	• **Methods:** linear salpingostomy vs. salpingectomy • **Indications for surgery** (either by laparoscopic or open approach)**:** 1. Failed or contraindication to MTX Rx 2. Previous EP in same fallopian tube

[a]If patient is Rh−, **must** give anti-D g globulin (RhoGAM).

Dyspareunia (Figure 10.17)

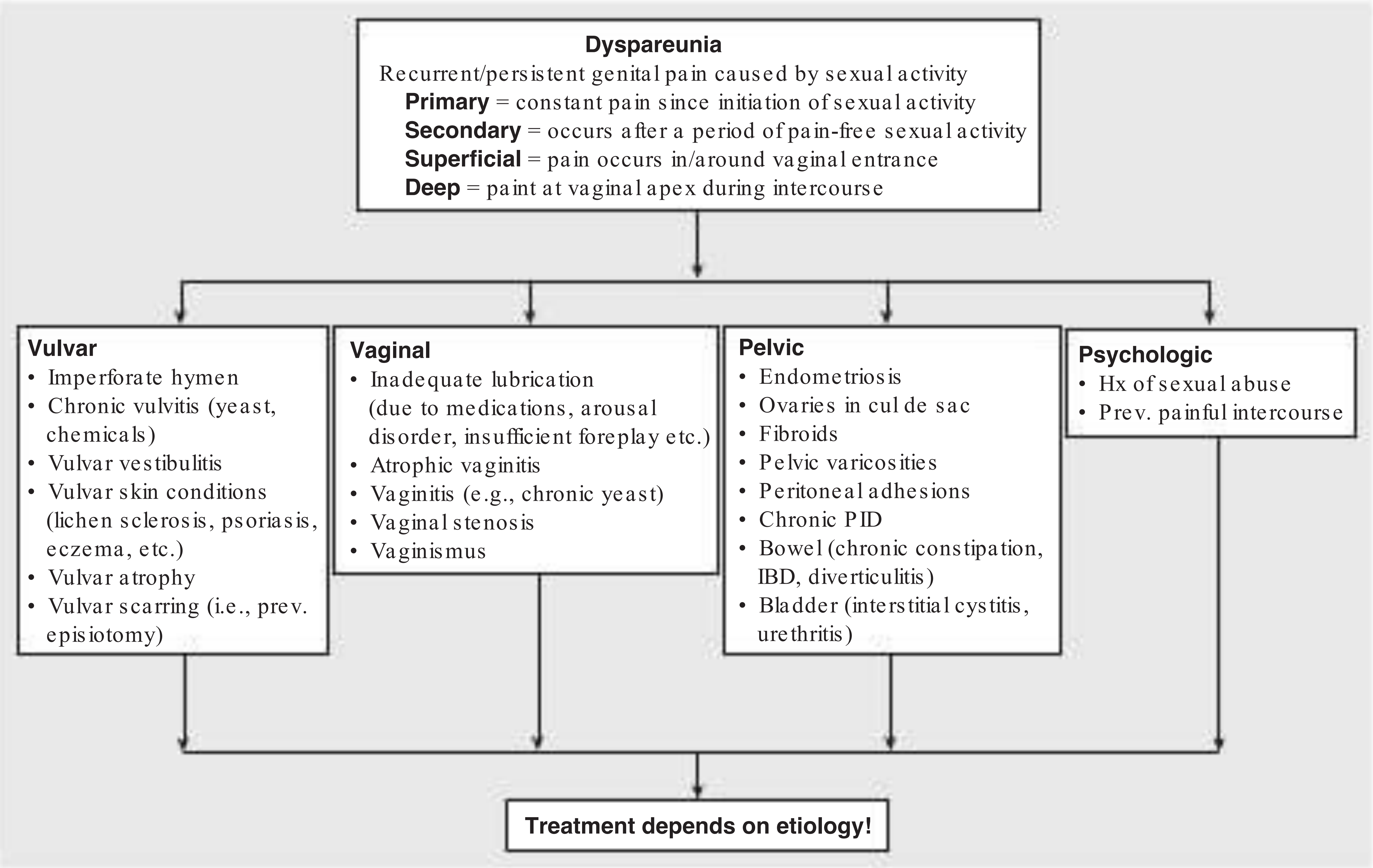

Dyspareunia
Recurrent/persistent genital pain caused by sexual activity
Primary = constant pain since initiation of sexual activity
Secondary = occurs after a period of pain-free sexual activity
Superficial = pain occurs in/around vaginal entrance
Deep = paint at vaginal apex during intercourse
Vulvar
• Imperforate hymen
• Chronic vulvitis (yeast, chemicals)
• Vulvar vestibulitis
• Vulvar skin conditions (lichen sclerosis, psoriasis, eczema, etc.)
• Vulvar atrophy
• Vulvar scarring (i.e., prev. episiotomy)
Vaginal
• Inadequate lubrication (due to medications, arousal disorder, insufficient foreplay etc.)
• Atrophic vaginitis
• Vaginitis (e.g., chronic yeast)
• Vaginal stenosis
• Vaginismus
Pelvic
• Endometriosis
• Ovaries in cul de sac
• Fibroids
• Pelvic varicosities
• Peritoneal adhesions
• Chronic PID
• Bowel (chronic constipation, IBD, diverticulitis)
• Bladder (interstitial cystitis, urethritis)
Psychologic
• Hx of sexual abuse
• Prev. painful intercourse
Treatment depends on etiology!

Figure 10.17. Approach to dyspareunia.

Indications for Speciality Referral in CPP

- Persistent pain despite a 3 to 6 mo trial of NSAIDs or OCPs
- Lack of Dx despite appropriate diagnostic investigations

PELVIC PROLAPSE

MCC OBJECTIVE

Based on Objective #83 (Uterine Prolapse, Pelvic Relaxation) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Herniation of one of the pelvic organs (uterus, vaginal apex, bladder, rectum) and its associated vaginal segment from its normal location (for types of female GU prolapse, see Table 10.52)
- Prolapse is a common condition

TABLE 10.52 • Types of female GU prolapse

Cystocele	Herniation of the bladder with associated descent of the anterior vaginal segment
Uterine prolapse	Descent of the uterus and cervix
Vaginal vault prolapse	Descent of the vaginal apex (posthysterectomy)
Rectocele	Herniation of the rectum with associated descent of the posterior vaginal segment
Enterocele	Herniation of the small bowel with associated descent of the posterior vaginal segment

APPLIED SCIENTIFIC CONCEPT

- Pelvic organs are supported by the pelvic floor musculature, fascial supports, and nervous system.
- Prolapse results from site-specific fascial defects causing vaginal segment weakness.
- The muscular pelvic floor is composed of the **levator ani** (combination of puborectalis, pubococcygeus, and iliococcygeus) and the **coccygeus muscles** attached to elements of the bony pelvis, coccyx, and sacrum.

CAUSAL CONDITIONS

The majority of women with clinically significant prolapse will have at least two RFs:

- Damage to support
  - Obstetric causes: pregnancy (multiparity), delivery (vacuum/forceps), fetal macrosomia, perineal laceration (third- and fourth-degree tears)
  - Surgical causes: hysterectomy
  - Estrogen deficiency
  - Chronically ↑ abdo pressure: obesity, smoking, pulmonary disease (chronic cough), constipation (chronic strain), recreational/occupational activities (weight lifting), ascites
  - Pelvic masses
- Neuromuscular/connective tissue disorders
- Genetics

Classifying prolapse

- Many systems for staging prolapse have been described:
  - Stage 0: no prolapse
  - Stage I: most distal prolapse is 1 cm above the hymen.
  - Stage II: most distal prolapse between 1 cm above or below the hymen
  - Stage III: most distal prolapse > 1 cm distal to the hymen
  - Stage IV: total prolapse ("procidentia")

CLINICAL box

Parity

Although ↑ parity is a RF for prolapse, nulliparity does not provide absolute protection against prolapse.

CLINICAL box

Occult/Latent Incontinence

Many women with anterior vaginal prolapse are continent either due to a competent urethral sphincter (despite lack of support) or an incompetent sphincter kinked by the prolapse, which when repaired results in new onset of stress incontinence known as occult/latent stress incontinence.

Stress incontinence is not a Sx of prolapse, rather a coincident Sx.

CLINICAL box

PVR Normal

There is no consensus on PVR cut-off normal values. If the initial voided volume is > 150 mL, a PVR of < 100 mL is indicative of appropriate bladder emptying. A PVR of > 100 mL indicates impaired bladder emptying, which may or may not be due to prolapse.

- Standard system approved by the International Continence Society is the POP-Q.
  - Measures nine locations on the vagina and vulva in centimeters relative to hymen
  - More detailed than necessary for clinical care, but used routinely in studies

AppROACH (Table 10.53)

TAbLE 10.53 • Evaluation of pelvic prolapse

Hx	Physical Exam	Investigations
• Pelvic pressure/heaviness • Protrusion of tissue from vagina • Inability to wear tampons • Incontinence, including urge or stress • Defecatory dysfunction • Excessive straining • Difficult or incomplete emptying of bladder or bowel • Digitation to aid in urination or defecation ("splinting") • ↓ Sexual activity (due to fear/ embarrassment/incontinence) • Vaginal bleeding (due to mucosal irritation) • Screen for prolapse risk factors • PMH, Sx, Hx, meds, social Hx	• Inspect vulva and vagina for erosions/ ulcerations and estrogen status • Examine all aspects of vaginal support: a. In dorsal lithotomy position without pessary b. Using single-bladed speculum to retract anterior/posterior/lateral vaginal walls • Standing straining exam to assess maximal prolapse • Examine for stress incontinence • Digital assessment of pelvic muscle/anal sphincter baseline **and** voluntary contraction tone (strength, duration, symmetry) • ± Rectovaginal exam to detect enterocele • Neuro exam: lower extremity neuromuscular exam	• **No specific tests for prolapse** • **Imaging not usually necessary** (unless procidentia to R/O urinary retention) • Biopsy all suspicious persistent vulvovaginal lesions • Cystocele evaluation: a. UTI screen b. Postvoid residual (PVR) • ± Refer to gynecologist for urodynamic testing

Management

All patients with defecatory dysfunction should be evaluated from a GI perspective and receive age-appropriate screening for colorectal CA.

Conservative

- Provide information and reassurance
- Appropriate for women whose Sx are not sufficiently bothersome to warrant active intervention
- F/U exams as needed
- Behavioral changes to modify risk factors (e.g., improved asthmatic control, smoking cessation, weight loss, etc.)

Nonsurgical

- Sx relief and **prevention of worsening prolapse**
- Reasonable choice when observation not suitable but surgery high-risk or refused by patient

Pelvic Floor Muscle Training

- Improving support to pelvic organs with ↑ strength and endurance of pelvic muscles
- No evidence for treating or preventing prolapse, but may benefit
- Is effective for urinary and fecal incontinence

Pessaries

- Device placed in vagina to provide support and/or fill space
- Support pessaries (the ring) for earlier stages (II and III)
- Space-filling pessaries (Gellhorn) for more advanced prolapse
- Ideally changed and rinsed weekly with F/U q3mo
- Lubricants or vaginal E (if atrophy) is often employed with pessaries in postmenopausal women

Surgical

- An attempt to improve prolapse Sx and concomitant Sx (GI, urinary, and sexual) through techniques to restore normal anatomy or obliterate the vagina
- Surgery may combine repairs to anterior vagina, vaginal apex, posterior vagina, and perineum, as well as concomitant bladder neck or anal sphincter repair

CLINICAL box

Relative Contraindications to pessary

- Inability to comply with pessary maintenance → risk rectovaginal or vesicovaginal fistulae
- Persistent vaginal erosions (consider local E, change size of pessary or potential vaginal neoplasm)
- Active genital infection or neoplasm

CLINICAL box

Indications for Surgery

- Surgery not recommended in woman with asymptomatic prolapse
- If advanced prolapse and asymptomatic: must assess efficiency of bladder emptying due to risk for complications of urinary retention (recurrent UTI, urosepsis) and assess exposed vaginal epithelium for erosions at risk for infection
- More frequent F/U (q3mo) if decided against surgery
- Patient fails conservative management, is unable or unwilling to use pessary, or desires surgical management

FEMALE URINARY INCONTINENCE

MCC OBJECTIVE

Based on Objective #47-2 (Incontinence, Urine, Adult) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW (Table 10.54)

TABLE 10.54 • Types of UI

Urinary Incontinence (UI)	Involuntary loss of urine
Stress Incontinence (SI)	Involuntary leakage of urine during effort, exertion, sneezing, or coughing
Urodynamic SI	When SI is confirmed during urodynamic testing by identifying leakage from the urethra coincident with ↑ intra-abdo pressure, but in the absence of bladder contraction
Urge incontinence	involuntary loss of urine with a strong desire to void Note: Involuntary bladder contractions (detrusor overactivity) are the hallmark of Dx.
Overflow incontinence	Large volume of urine in bladder due to incomplete emptying
Continuous incontinence	Continuous leakage of urine due to vesicovaginal fistula

CLINICAL box

Geriatrics

UI has been shown to improve or resolve after removal of fecal impactions in institutionalized geriatric patients.

Epidemiology

- Up to 70% of women living in the community setting and up to 50% of nursing home residents are affected by UI.
- Prevalence of incontinence increases with increasing age.
- Approximately one in four women with UI seeks medical help.
- Among ambulatory women with incontinence, SI represents 29% to 75%, detrusor overactivity 7% to 33%, and the remainders are mixed forms.

CAUSAL CONDITIONS (Table 10.55)

TABLE 10.55 • DDx of UI in women

GU Etiology	Non-GU Etiology
• Problem with filling/storing: ◦ SI ◦ Detrusor overactivity (idiopathic or neurogenic) ◦ Mixed types • Fistula (vesical, ureteral, urethral) • Congenital (i.e., ectopic ureter) • Urinary retention and overflow incontinence • UTI/urethritis • Atrophic urethritis/vaginitis • Pregnancy	• Functional: ◦ Cognitive ◦ Neurologic ◦ Psychological ◦ Physical impairment • Pharmacologic • Metabolic/endocrine ◦ Hyperglycemia, hypercalcemia, diabetes insipidus ◦ ↑↑↑ Fluid intake (psychogenic polydipsia) • Delirium • Volume overload • Stool impaction

CLINICAL box

Medications Affecting Urinary Function

↑ Frequency

- Diuretics
- Caffeine/EtOH

Retention

- Narcotics
- Anticholinergics
- Antidepressants
- Antipsychotics
- α-Agonists
- Ca^{2+}-channel blockers

AppROACH (Table 10.56)

TAbLE 10.56 • Evaluation of urinary incontinence in women

Hx	Physical Exam	Investigations

• **Sx:** urgency, frequency, dysuria, nocturia, incomplete emptying, dribbling, pelvic bulge/pressure, medical Hx, hematuria, volume of incontinence
• Level of functional impairment (quality of life)
• Neurologic Hx (DM, stroke, lumbar disk disease)
• Smoking Hx (COPD)
• **Voiding diary** (3–7 d):
  • Daytime and nocturnal voiding frequency and fluid intake (caffeine, EtOH)
  • Incontinence episodes
• Recurrent UTIs, GI Hx (incontinence, constipation)
• OB/GYN Hx (hysterectomy, vaginal repair, pelvic radiotherapy)
• Medication list
	• **General physical exam including mental status**
	• **Pelvic exam:**
	  • Vulvar or vaginal atrophy
	  • Assess pelvic organ prolapse
	  • Bimanual exam—R/O gyn pathology
	  • Rectal exam—anal sphincter tone
	  • "Cough test"—visualize leakage from urethra at time of cough with full bladder, and if pelvic organ prolapse, repeat with restoration of vaginal anatomy
	• Neurologic exam (S2–4 control micturition):
	  • Sensation: perineum, sacral dermatomes of lower extremities
	  • Motor: strength and tone of bulbocavernosus muscle, levators, external anal sphincter, and lower extremities
		• PVR
		• U/A (R/O UTI)
		• Consider serum urea, Cr, glucose, and Ca^{2+}
		Referral to gynecologist or urogynecologist for further testing (i.e., urodynamics, cystoscopy)

For an algorithm to assess for SI versus Detrusor Overactivity, see Figure 10.18.

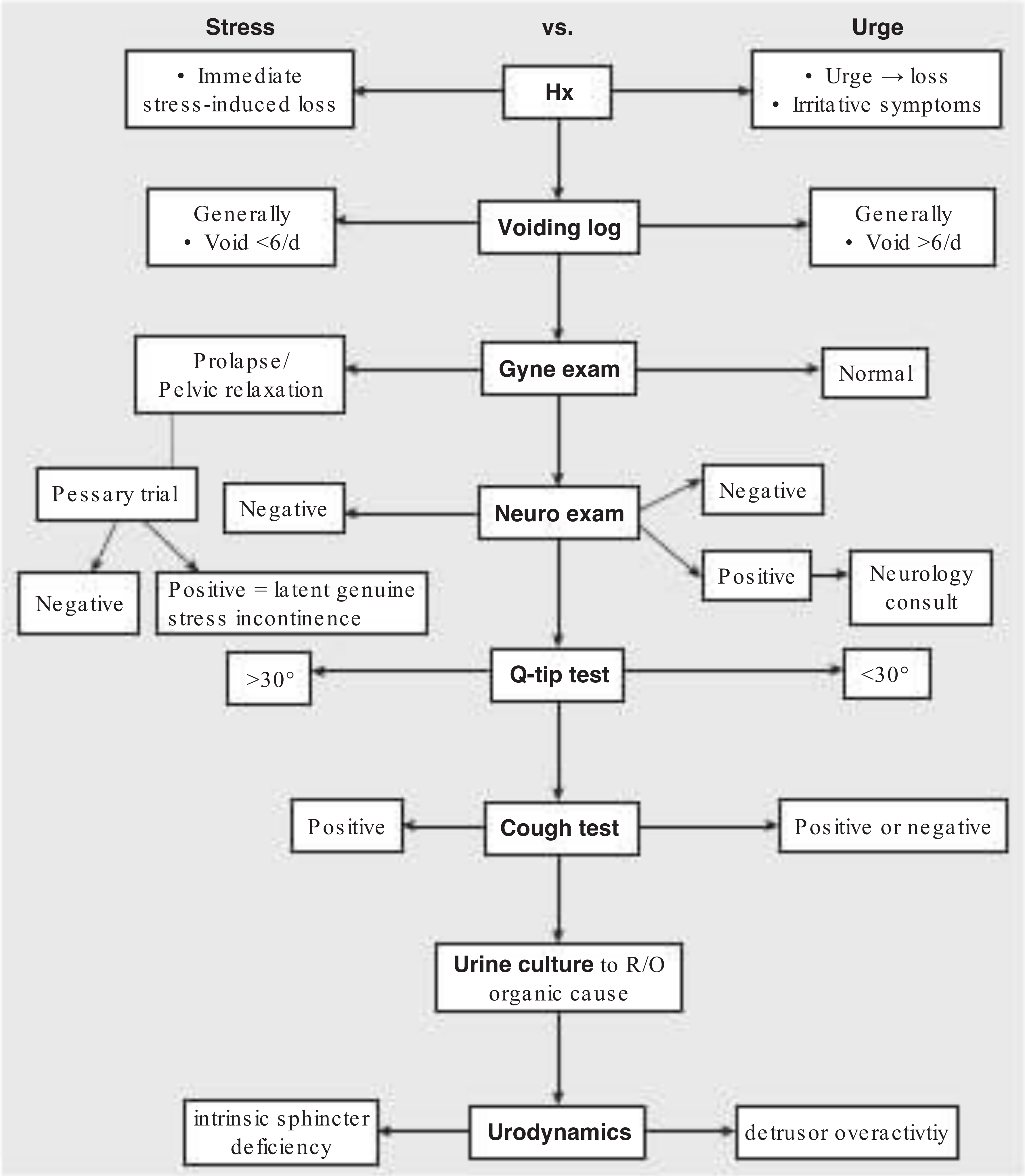


Figure 10.18. Algorithm to assess for SI versus detrusor overactivity.

Management (Table 10.57)

TABLE 10.57 • Management of urinary incontinence

Stress Incontinence	Urge Incontinence
1. **Behavioral approaches:** • **Lifestyle interventions**: weight loss, ↓ caffeine/fluid intake, smoking cessation, D activities/exercise, relief of constipation, timed voiding • **Pelvic muscle exercises** (aka Kegel): strengthen voluntary urethral sphincter and levator ani muscles; 3 repetitions of 8–10 sustained muscle contractions, 3–4 times weekly; not to be done during urination! • **Biofeedback** 2. **Medical management** • New evidence **against estrogen therapy** for Rx of SI 3. **Devices** (pessaries) 4. **Surgical management** (refer to gynecologist)	1. **Lifestyle modifications:** caffeine/fluid reduction, reduce bladder irritants 2. **Behavioral approaches** • **"Bladder retraining"** (aka bladder drills or timed voiding): schedule to ↑ interval between voids. • **Pelvic muscle exercises** (aka Kegel) • **Biofeedback** 3. **Medical management:** • Tricyclic antidepressants or anticholinergic agents, selective b-receptor agonist 4. **Surgical management and devices:** sacral nerve modulation 5. Botox injections into bladder

FEMALE INFERTILITY

MCC OBJECTIVE

Based on Objective #46 (Infertility) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW (Table 10.58)

TABLE 10.58 • Definitions of infertility

Infertility	Inability to conceive after 1 yr of regular intercourse **without** contraception
Fecundability	Probability that a single cycle will result in **pregnancy** (20%–25%)
Fecundity	Probability that a single cycle will result in a **live birth**

- In women, there is a significant age-related ↓ fertility and ↑ in spontaneous miscarriage largely attributable to progressive follicular depletion and ↑ incidence of abnormalities of aging oocytes.
- Must investigate both partners to identify the cause of infertility and then tailor the Rx accordingly.
- Infertility affects approximately 15% of couples.
- Female-associated factors account for approximately 50% of infertility problems.
- Male-associated factors contribute significantly to infertility in up to approximately 35% of couples.
- Approximately 10% to 15% of couples will have "unexplained infertility" (cause is uncertain).

ASC box

Menstrual Cycle

Menstrual phase: 1 to 4 d
Follicular phase: 5 to 13 d
Ovulation: 14 d
Luteal phase: 15 to 28 d

CAUSAL CONDITIONS (Table 10.59)

TABLE 10.59 • DDx of female factor infertility

Mechanism	DDx		
Ovulatory dysfunction (20%–40%)	• Hypothalamic (hypothalamic disorder 2° to stress, poor diet, or excessive exercise) • Pituitary (prolactinoma, medication-induced, hypopituitarism) • PCOS • POI • Systemic disease (thyroid dysfunction) • Anovulation associated with transition to menopause		
Anatomic abnormality (25%–35%)	**Uterine factors (, 5%)** • Infection (chronic endometritis) • Fibroids • Congenital anomalies (agenesis, uterine septum, bicornuate uterus) • Asherman syndrome	**Cervical factors (5%)** • Acidic cervical mucus • Antisperm antibodies • Structural defects (previous LEEP, cone biopsy, cryo/laser Rx)	**Tubal factors (30%–40%)** • PID • Tubal occlusion (previous ectopic) • Tubal adhesions (previous surgery, endometriosis)
Other (40%–45%)	• Endometriosis • Multifactorial • Unexplained		

CLINICAL box

Lifestyle factors Associated with ä Infertility

- Obesity
- Smoking
- EtOH use
- Drug use
- Caffeine

CLINICAL box

Risk factors for Tubal Infertility

- Hx of PID
- Hx of tubal or pelvic surgery
- Hx of endometriosis
- Prev. EP
- *In utero* DES exposure
- Hx of septic abortion

APPROACH (Figure 10.19)

- Evaluate for male infertility factor (see Urology—Male Infertility)
- Determine whether patient cycles are ovulatory
- Identify factors that ↑ risk of tubal infertility
- Examine patient for signs and Sx of endocrinopathy and gynecologic disease

CLINICAL box

Evaluation of Coital Practices

- Sexual dysfunction (dyspareunia, impotence, etc.)
- Frequency of intercourse
- Timing of intercourse
- Use of lubricants

Physician's Approach to Infertility

- Discuss in a nonjudgmental manner
- Full disclosure to patients (make certain patients have full access to relevant information)
- Identify if certain options lie outside your moral boundaries and refer to another MD if appropriate
- Protect the patients' right to freedom of moral choice

Can MED

Evaluation of Infertility

- All couples who have failed to conceive after ≥ 1 yr of unprotected intercourse
- One year of infertility is not a prerequisite for:
  - All women > 35 yr
  - Women with irregular or infrequent menses
  - Women with a Hx of PID or endometriosis

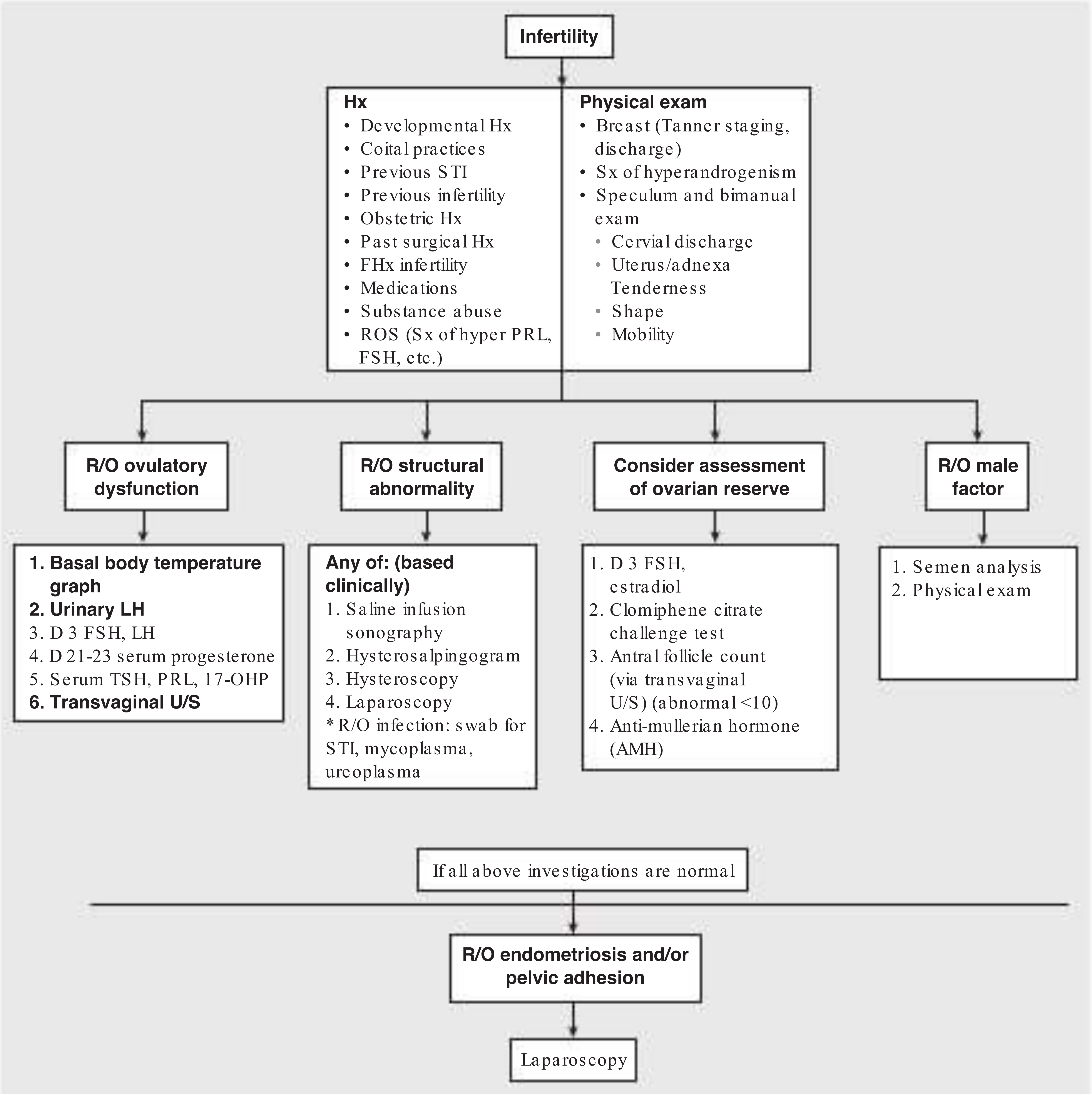

Infertility
Hx
• Developmental Hx
• Coital practices
• Previous STI
• Previous infertility
• Obstetric Hx
• Past surgical Hx
• FHx infertility
• Medications
• Substance abuse
• ROS (Sx of hyper PRL, FSH, etc.)
Physical exam
• Breast (Tanner staging, discharge)
• Sx of hyperandrogenism
• Speculum and bimanual exam
• Cervial discharge
• Uterus/adnexa Tenderness
• Shape
• Mobility
R/O ovulatory dysfunction
1. Basal body temperature graph
2. Urinary LH
3. D 3 FSH, LH
4. D 21-23 serum progesterone
5. Serum TSH, PRL, 17-OHP
6. Transvaginal U/S
R/O structural abnormality
Any of: (based clinically)
1. Saline infusion sonography
2. Hysterosalpingogram
3. Hysteroscopy
4. Laparoscopy
*R/O infection: swab for STI, mycoplasma, ureoplasma
Consider assessment of ovarian reserve
1. D 3 FSH, estradiol
2. Clomiphene citrate challenge test
3. Antral follicle count (via transvaginal U/S) (abnormal <10)
4. Anti-mullerian hormone (AMH)
R/O male factor
1. Semen analysis
2. Physical exam
If all above investigations are normal
R/O endometriosis and/or pelvic adhesion
Laparoscopy

Figure 10.19. Approach to infertility. Ovarian reserve: the size and quality of the remaining ovarian follicular pool intended to predict future fecundability or provide prognostic information regarding likelihood of successful Rx.

  - Men with known or suspected poor semen quality
  - Either partner has a Hx of chemotherapy or radiation

Indications for Specialty Referral in Couples Presenting with Female Infertility

Factor infertility (gynecologist and/or reproductive endocrinology and infertility specialist):

- Female with abnormal day 3 FSH and/or estradiol
- Female with abnormal hysterosalpingogram (HSG) due to:
  - Tubal abnormalities
  - Abnormal intrauterine cavity
- Women with laparoscopy showing severe pelvic adhesions
- Women in whom pregnancy fails to occur after surgical Rx of endometriosis
- Couples desiring IVF and/or other advanced reproductive technologies

CLINICAL box

prognosis

The majority of spontaneous pregnancies will occur within 1 yr, and especially after 3 yr, the prognosis for success without Rx is relatively poor.

Management

- Counseling and education (see Figure 10.20)

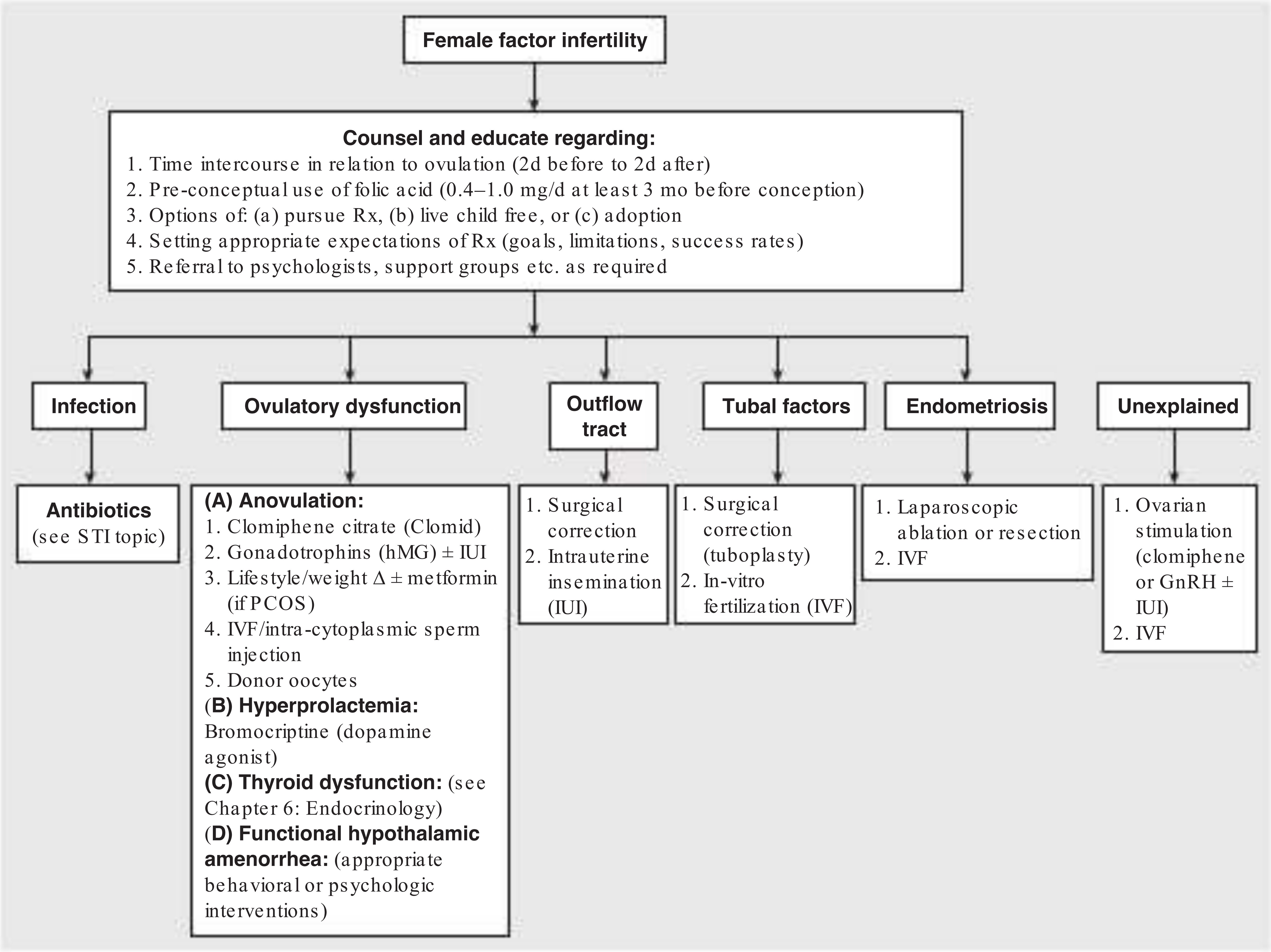

Female factor infertility
Counsel and educate regarding:
1. Time intercourse in relation to ovulation (2d before to 2d after)
2. Pre-conceptual use of folic acid (0.4–1.0 mg/d at least 3 mo before conception)
3. Options of: (a) pursue Rx, (b) live child free, or (c) adoption
4. Setting appropriate expectations of Rx (goals, limitations, success rates)
5. Referral to psychologists, support groups etc. as required
Infection
Ovulatory dysfunction
Outflow tract
Tubal factors
Endometriosis
Unexplained
Antibiotics (see STI topic)
(A) Anovulation:
1. Clomiphene citrate (Clomid)
2. Gonadotrophins (hMG) ± IUI
3. Lifestyle/weight Δ ± metformin (if PCOS)
4. IVF/intra-cytoplasmic sperm injection
5. Donor oocytes
(B) Hyperprolactemia: Bromocriptine (dopamine agonist)
(C) Thyroid dysfunction: (see Chapter 6: Endocrinology)
(D) Functional hypothalamic amenorrhea: (appropriate behavioral or psychologic interventions)
1. Surgical correction
2. Intrauterine insemination (IUI)
1. Surgical correction (tuboplasty)
2. In-vitro fertilization (IVF)
1. Laparoscopic ablation or resection
2. IVF
1. Ovarian stimulation (clomiphene or GnRH ± IUI)
2. IVF

Figure 10.20. Management of female factor infertility.

- Rx of ovulatory dysfunction by underlying etiology, for example, thyroid replacement for hypothyroidism
  - Ovulation induction using clomiphene citrate or gonadotropins
- Consider surgical management if abnormalities of the uterus, tube, or suspected pelvic adhesions
- Management of male factor infertility (donor insemination, intrauterine insemination, IVF, Intracytoplasmic Sperm Injection (ICSI); see Male Infertility)

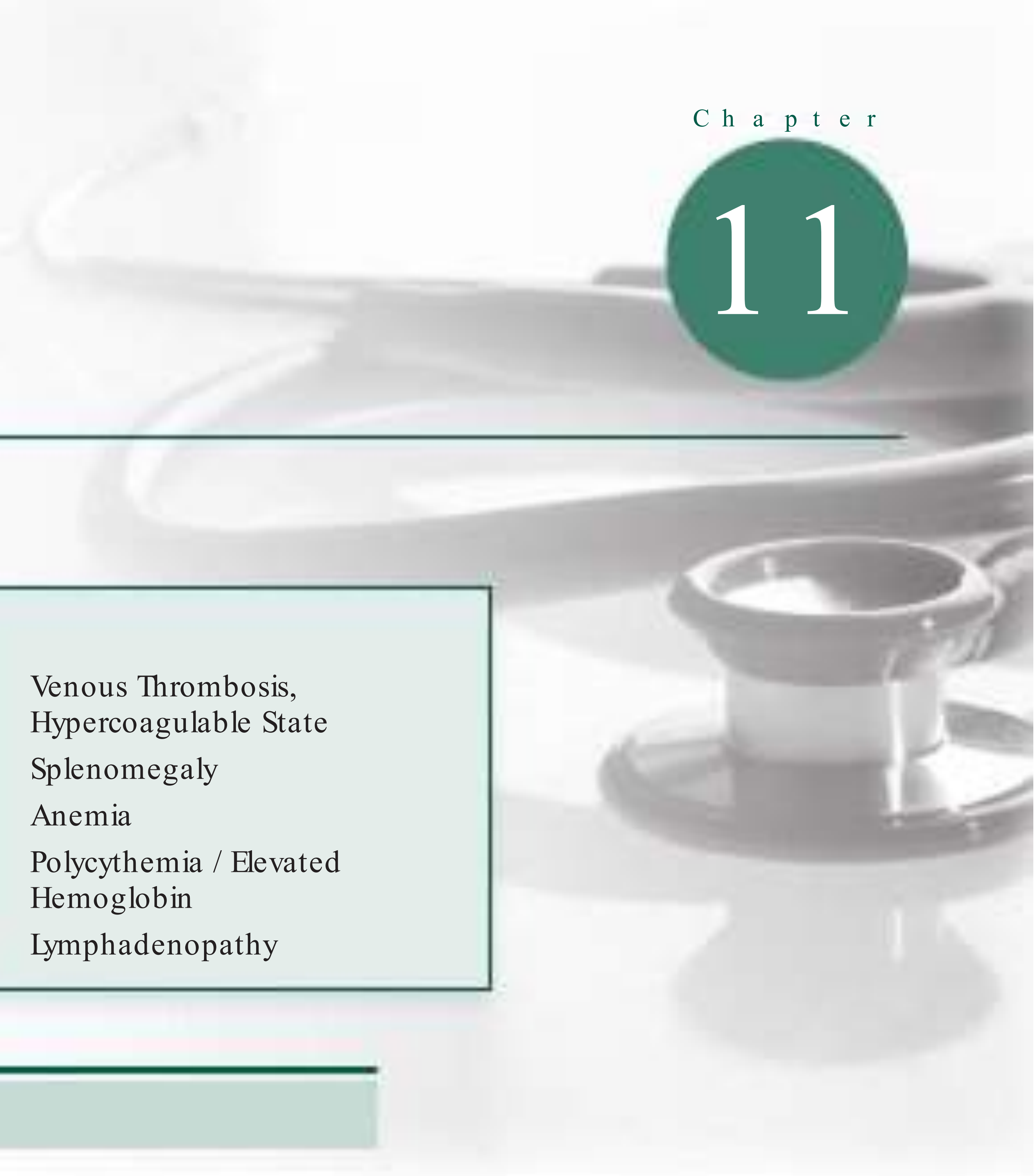
IVF

- Rx of choice for severe tubal disease, and severe sperm defects
- Indications:
  - Severe tubal disease
  - Advanced stage endometriosis
  - Severe male factor
  - Multifactor infertility
  - Age-related or otherwise unexplained subfertility
  - POI (with young donor egg)

SuGGESTED READINGS

Decherney AH, Nathan L, Goodwin TM, et al. *Current Diagnosis & Treatment, Obstetrics & Gynecology*. 11th ed. New York, NY: McGraw-Hill; 2012.

Hacker NF, Moore JG. *Essentials of Obstetrics and Gynecology*. 5th ed. Philadelphia, PA: WB Saunders; 2010.



Chapter

11

Hematology

Mark Belletrutti • Elena Liew

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FEVER OF UNKNOWN ORIGIN

MCC OBJECTIVE

Based on Objective #107-2 (Fever of Unknown Origin) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Definition:

- Body temperature ≥ 38.3°C on more than one occasion
- Duration ≥ 3 wk
- No diagnosis after 3 d of inpatient evaluation or three outpatient visits

APPLIED SCIENTIFIC CONCEPT

- Fever: body temperature (≥ 38.3°C)
- Hyperpyrexia: excessive fever (> 41.5°C) caused by ↑ in body's thermal set point
- Hyperthermia: ↑ in body temperature beyond the body's thermal set point
- Exogenous pyrogens: substances (notably microbial cell wall components, Lipopolysaccharides on bacteria) that induce the formation of endogenous pyrogens from host cells (primarily macrophages)
- Pyrogenic cytokines: cytokines (primarily IL-6) that act on the hypothalamus to ↑ body temperature by releasing PGE_2
- Antipyretics inhibit synthesis of PGE_2
- Corticosteroids inhibit phospholipase A_2
- ASA and NSAIDs inhibit cyclooxygenase

CLINICAL box

Classes of drugs

Associated with Fever

- Antimicrobials
- Anticonvulsants
- Antihistamines
- Cardiovascular drugs
- H_2 blockers
- Herbal remedies
- Iodides
- NSAIDs
- Phenothiazines
- Salicylates

CAUSAL CONDITIONS (Table 11.1)

TABLE 11.1 • Causal conditions by etiology for FUO

Infection	• Intra-abdominal abscess (hepatic, splenic, subphrenic, perinephric, pelvic, intestinal) • TB (pulmonary, extrapulmonary, miliary) • Endocarditis • Osteomyelitis, paraspinal abscess • Travel-associated infection
Malignancy	• Hematologic: lymphoma, leukemia • Solid tumor: colon CA, pancreatic CA, hepatocellular CA, renal cell CA

(Continued)

TABLE 11.1 • Continued

Collagen vascular disease	• Vasculitis (giant cell arteritis, polyarteritis nodosa, Wegener granulomatosis, etc.) • SLE • RA, adult-onset Still disease
Miscellaneous	• Drug induced • Endocrine (hyperthyroidism, pheochromocytoma, adrenal insufficiency) • Hematoma, DVT, PE • Familial Mediterranean fever • Factitious

APPROACH (Figure 11.1)

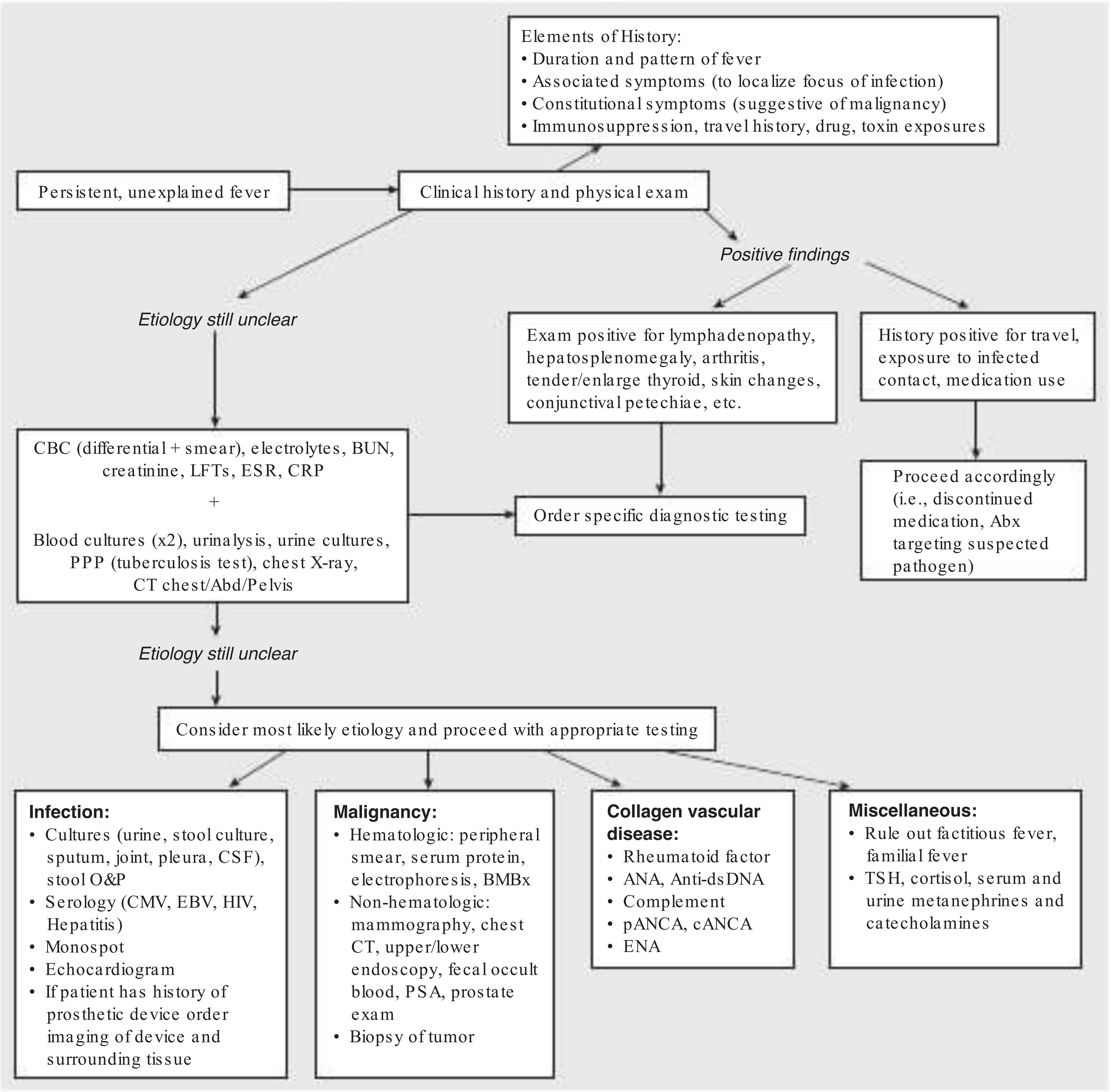

Elements of History:
• Duration and pattern of fever
• Associated symptoms (to localize focus of infection)
• Constitutional symptoms (suggestive of malignancy)
• Immunosuppression, travel history, drug, toxin exposures
Persistent, unexplained fever
Clinical history and physical exam
Positive findings
Etiology still unclear
Exam positive for lymphadenopathy, hepatosplenomegaly, arthritis, tender/enlarge thyroid, skin changes, conjunctival petechiae, etc.
History positive for travel, exposure to infected contact, medication use
CBC (differential + smear), electrolytes, BUN, creatinine, LFTs, ESR, CRP
+
Blood cultures (x2), urinalysis, urine cultures, PPP (tuberculosis test), chest X-ray, CT chest/Abd/Pelvis
Order specific diagnostic testing
Proceed accordingly (i.e., discontinued medication, Abx targeting suspected pathogen)
Etiology still unclear
Consider most likely etiology and proceed with appropriate testing
Infection:
• Cultures (urine, stool culture, sputum, joint, pleura, CSF), stool O&P
• Serology (CMV, EBV, HIV, Hepatitis)
• Monospot
• Echocardiogram
• If patient has history of prosthetic device order imaging of device and surrounding tissue
Malignancy:
• Hematologic: peripheral smear, serum protein, electrophoresis, BMBx
• Non-hematologic: mammography, chest CT, upper/lower endoscopy, fecal occult blood, PSA, prostate exam
• Biopsy of tumor
Collagen vascular disease:
• Rheumatoid factor
• ANA, Anti-dsDNA
• Complement
• pANCA, cANCA
• ENA
Miscellaneous:
• Rule out factitious fever, familial fever
• TSH, cortisol, serum and urine metanephrines and catecholamines

Figure 11.1. Approach to Fever of Unknown Origin.

FEVER IN THE IMMUNE COMPROMISED HOST / RECURRENT FEVER

MCC OBJECTIVE

Based on Objective #107-4 (Fever in the Immune Compromised Host/Recurrent Fever) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- A compromised immune system increases host susceptibility to opportunistic infections, which are caused by organisms that are usually of low virulence and maintained in a latent state by the intact immune system.
- The etiology and degree of immunosuppression predicts the type of organism and infection that may occur.

APPLIED SCIENTIFIC CONCEPT

- **CMI (Cell-Mediated Immunity):** composed of T lymphocytes, macrophages, and NK (Natural Killer) cells.
  - Major defense against intracellular pathogens.
  - Cytotoxic T cells directly attack and lyse host cells expressing foreign antigens.
  - Helper T cells stimulate B-cell proliferation and production of immunoglobulins (Ab).
  - Reticuloendothelial system (RES) refers to monocyte-derived phagocytes in the liver, spleen, lymph nodes, and lung that clear circulating microorganisms.
- **Humoral immune system:** includes Ab, complement system, and phagocytes.
  - Defends against extracellular pathogens, including encapsulated bacteria.
  - Ab produced by mature B cells that recognize and bind foreign antigens.
  - Proteins of the complement system can act as opsonins, "tagging" pathogens for destruction by phagocytes. Terminal complement proteins can directly kill some pathogens by forming a membrane attack complex.
- **Neutrophils:** engulf and destroy pathogenic microbes.
  - Circulating neutrophils localize to sites of infection via adhesion molecules expressed by endothelial cells.
  - They diapedesis into the extravascular space and further localization occur via chemokines and chemoattractants.

CLINICAL box

Typical Infectious Organisms in CMI Defects versus Asplenia/ Hypogammaglobulinemia

CMI defects predispose to infection with intracellular pathogens:

- Bacteria (*L monocytogenes*, *Salmonella* spp., *Legionella* spp., and *mycobacterial* spp.)
- Fungal (*C neoformans*, *Candida* spp., *P jirovecii/carinii*)
- Parasitic (*T gondii*)
- Viral (varicella zoster, HSV, CMV)

Hypogammaglobulinemia and asplenia predispose to infection with encapsulated bacteria: *S pneumoniae*, *H influenza*, *N meningitidis*

CAUSAL CONDITIONS (Table 11.2)

TABLE 11.2 • Causes of Immunocompromised State

Hematologic factors of host defense	CMI	• Lymphocytes ◦ Acquired CMI defects (1°—HIV/AIDS, 2°—Hodgkin, immunosuppressive Rx, lymphocytic leukemia) ◦ Inherited CMI defect ◦ Natural killer cell deficiency • Phagocytes ◦ Deficiencies in phagocytosis (1°/acquired) ◦ Neutropenia
	Circulating proteins	• Immunoglobulins ◦ Loss (GI/renal diseases) ◦ ↓ Production • Complement deficiencies
	Splenic function	• Hyposplenism/functional asplenia (hemoglobinopathy [sickle cell disease], congenital) • Therapeutic splenectomy (splenic injury/trauma, malignancy, thrombocytopenia, hemolytic anemia)

(Continued)

ASC box

Complement and Immune Dysfunction

Normally involved in inducing inflammation, leukocytosis; protective against viruses; improves bacterial opsonization; produces bacterial cell wall/membrane lysis

Inherited complement deficiencies predispose to frequent and recurrent infections with encapsulated bacteria.

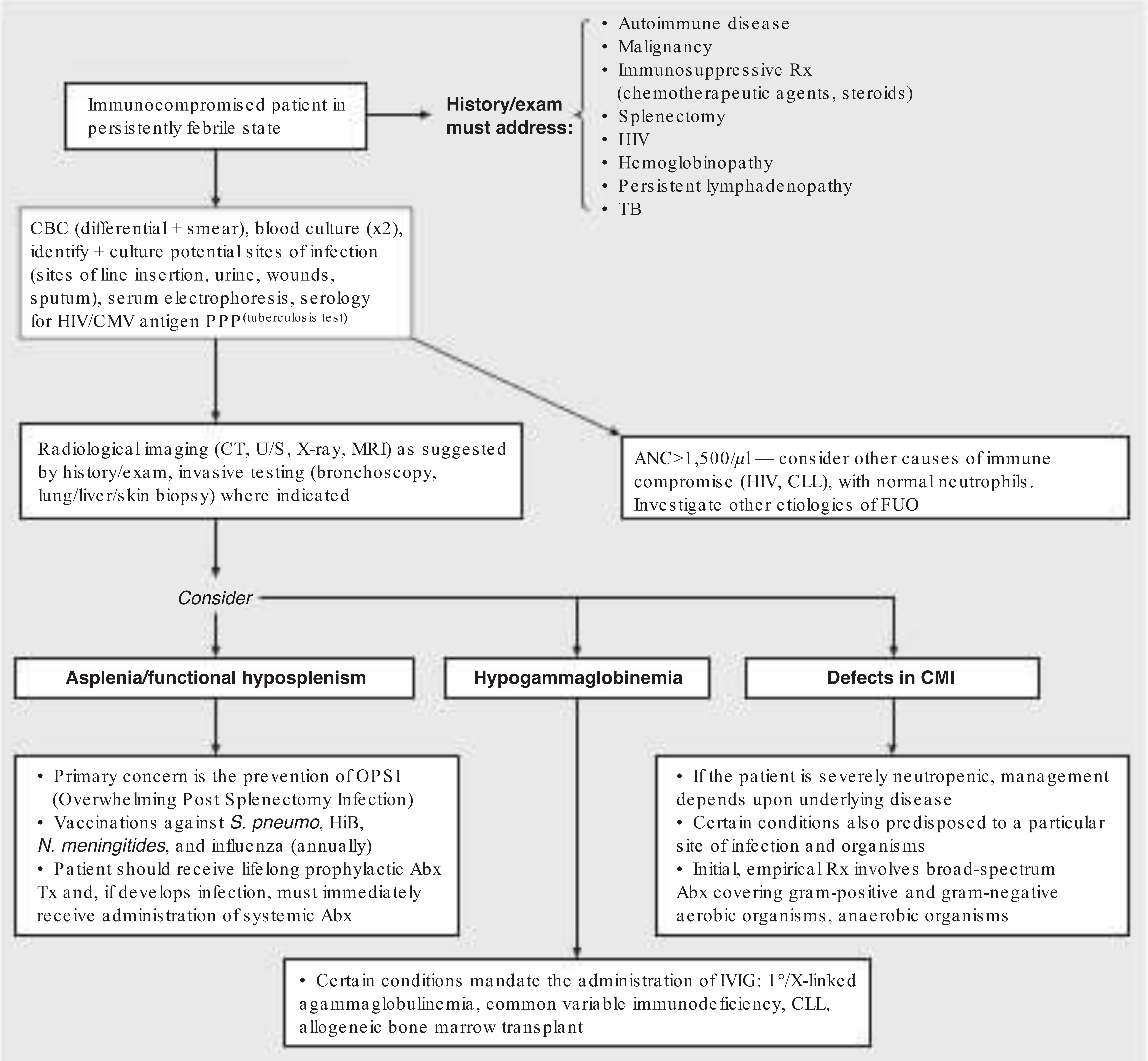
Acquired complement deficiencies can develop with rheumatologic disorders (SLE).

TABLE 11.2 • Continued

Extrahematologic	• Anatomic barriers are abnormal. • Surgery • Foreign bodies • Burns • Desquamating rash

APPROACH

Fever in the Immunocompromised Host (Figure 11.2)



Immunocompromised patient in persistently febrile state

- Autoimmune disease
- Malignancy
- Immunosuppressive Rx (chemotherapeutic agents, steroids)
- Splenectomy
- HIV
- Hemoglobinopathy
- Persistent lymphadenopathy
- TB

CBC (differential + smear), blood culture (x2), identify + culture potential sites of infection (sites of line insertion, urine, wounds, sputum), serum electrophoresis, serology for HIV/CMV antigen PPP (tuberculosis test)

Radiological imaging (CT, U/S, X-ray, MRI) as suggested by history/exam, invasive testing (bronchoscopy, lung/liver/skin biopsy) where indicated

ANC>1,500/µl — consider other causes of immune compromise (HIV, CLL), with normal neutrophils. Investigate other etiologies of FUO

- Primary concern is the prevention of OPSI (Overwhelming Post Splenectomy Infection)
- Vaccinations against *S. pneumo*, HiB, *N. meningitides*, and influenza (annually)
- Patient should receive lifelong prophylactic Abx Tx and, if develops infection, must immediately receive administration of systemic Abx

- If the patient is severely neutropenic, management depends upon underlying disease
- Certain conditions also predisposed to a particular site of infection and organisms
- Initial, empirical Rx involves broad-spectrum Abx covering gram-positive and gram-negative aerobic organisms, anaerobic organisms

- Certain conditions mandate the administration of IVIG: 1°/X-linked agammaglobulinemia, common variable immunodeficiency, CLL, allogeneic bone marrow transplant

Figure 11.2. Approach to fever in the immunocompromised host.

Physical Exam and Investigations of Neutropenic Patients (Table 11.3)

ASC box

T Cells

- 1° Mediators of CMI
- Ab production requires intact T-cell number and function (stimulation of B-cell proliferation by IL-2)

TABLE 11.3 • Classical findings in neutropenic patients and their associated pathogens

Physical exam	
Oral mucositis	Viridans streptococci, HSV, Candida spp.
Black eschar	Aspergillus, Mucor
Necrotizing skin lesions	P. aeruginosa, Aspergillus
Subcutaneous nodules (nontender)	Nocardia, Cryptococcus
Skin papules (nontender)	Candida
RLQ abdominal tenderness (± pain, distension, bloody diarrhea)	Typhlitis (neutropenic enterocolitis) 2° to Pseudomonas, E. coli, Clostridium spp.
Perineal tenderness	Gram-negative bacilli, anaerobes
Inflammation/pain at IV, catheter site	Coagulase negative staph, Corynebacterium, Bacillus spp.
Chest radiography	
Localized infiltrate	Bacterial/mycobacterial pathogens
Nodular infiltrate	Nocardia, filamentous fungi
Cavitary lesions	Aspergillus
Diffuse interstitial infiltrate	P. jirovecii, viral pathogen
Fever	
Fever persists after 1 wk of antimicrobial Rx	Filamentous fungal infection
Fever persists after resolution of neutropenia	Hepatosplenic candidiasis

WHITE BLOOD CELL ABNORMALITIES

MCC OBJECTIVE

Based on Objective #120 (White Blood Cells Abnormalities) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Abnormalities of WBC include quantitative as well as functional abnormalities.
- High WBC counts (leukocytosis) as well as low WBC counts (leukopenia) may be indicative of a 1° bone marrow disorder, or may reflect a response to systemic illness.
- Disorders of leukocyte function may be congenital or acquired.

APPLIED SCIENTIFIC CONCEPT

- Neutrophils are derived from a common progenitor that also gives rise to erythrocytes, megakaryocytes, and monocytes.
- Proliferation of the common progenitor is stimulated by IL-3 and GM-CSF.
- Later differentiation is regulated by granulocyte colony–stimulating factor.
- Production of granulocytes involves movement from marrow to blood to tissue.
- The peripheral neutrophil count reflects equilibrium between several compartments.
- WBC count and differential measures only neutrophils in the circulating pool during their brief 3- to 6-h period of transit from the bone marrow to tissue.
- Polymorphonuclear leukocytes (PML) granules contain toxic substances.
- Neutrophils migrate to sites of infection or inflammation via paracellular and transcellular routes through endothelial cell layers.

CAUSAL CONDITIONS

Neutropenia and Neutrophilia (Tables 11.4 and 11.5)

TABLE 11.4 • Causes of neutropenia and neutrophilia

Neutropenia (ANC , 1.5 3 10^9/L)	
Decreased production	• Primary marrow disorders: aplastic anemia, MDS, leukemia, marrow replacement • B_{12}/folate deficiency • Infection, sepsis • Drugs (chemotherapy, anticonvulsants, NSAIDs, antithyroid medications, antipsychotics)
Increased destruction	• Associated autoimmune disease: SLE, RA (Felty's) • Drugs (penicillin, gold, quinidine)
Sequestration	• Splenomegaly
Constitutional/normal variant	• Usually seen in patients of African descent
Neutrophilia (ANC . 7.5 3 10^9/L)	

Increased production	• Reactive
	  • Infection (usually bacterial)
	  • Collagen vascular disease
	  • Tissue damage/necrosis
	  • Acute hemorrhage
	  • Hemolytic anemia
	  • Pregnancy (3rd trimester)
	  • Drugs: G-CSF, steroids, epinephrine, lithium
	• Myeloproliferative disease

Decreased destruction	• Hyposplenism, asplenia
Decreased margination	• Drugs (epinephrine, glucocorticoids, NSAIDs) • Vigorous physical exertion, other stress

TABLE 11.5 • Causes of leukocyte dysfunction

Congenital	Acquired
Chronic granulomatous disease	Autoimmune disorders (RA, SLE)
Myeloperoxidase deficiency	Diabetes mellitus
Leukocyte adhesion deficiency type 1	Hemodialysis
Chediak-Higashi syndrome (childhood recessive autoimmune disorder)	

Lymphocytosis (Table 11.6)

TABLE 11.6 • Causes of lymphocytosis (. 4 3 10^9/l)

Infection	Usually viral (EBV, CMV, viral hepatitis), pertussis, toxoplasmosis
Hypersensitivity	Drug induced, serum sickness
Neoplastic	ALL, CLL, lymphoma
Stress	Cardiac emergencies, trauma, status epilepticus, postsplenectomy
Autoimmune	RA, malignant thymoma

ASC box

Leukemoid Reaction

- Persistent neutrophilia with WBC counts from 30,000 to 50,000/mL; circulating neutrophils tend to be mature and not clonally derived (contrast with leukemia)
- Most frequently associated with septicemia and severe bacterial infections, including shigellosis, salmonellosis, meningococcemia
- If 12% of all cells are immature, then it is known as left shift and indicates a rapid release of cells from bone marrow
- May see ↑ in band forms and in metamyelocytes/myelocytes, which usually do not circulate
- Higher degree of left shift is associated with more immature neutrophil precursors and suggests serious bacterial infection, trauma, burns, surgery, acute hemolysis, or hemorrhage

APPROACH (Figure 11.3)

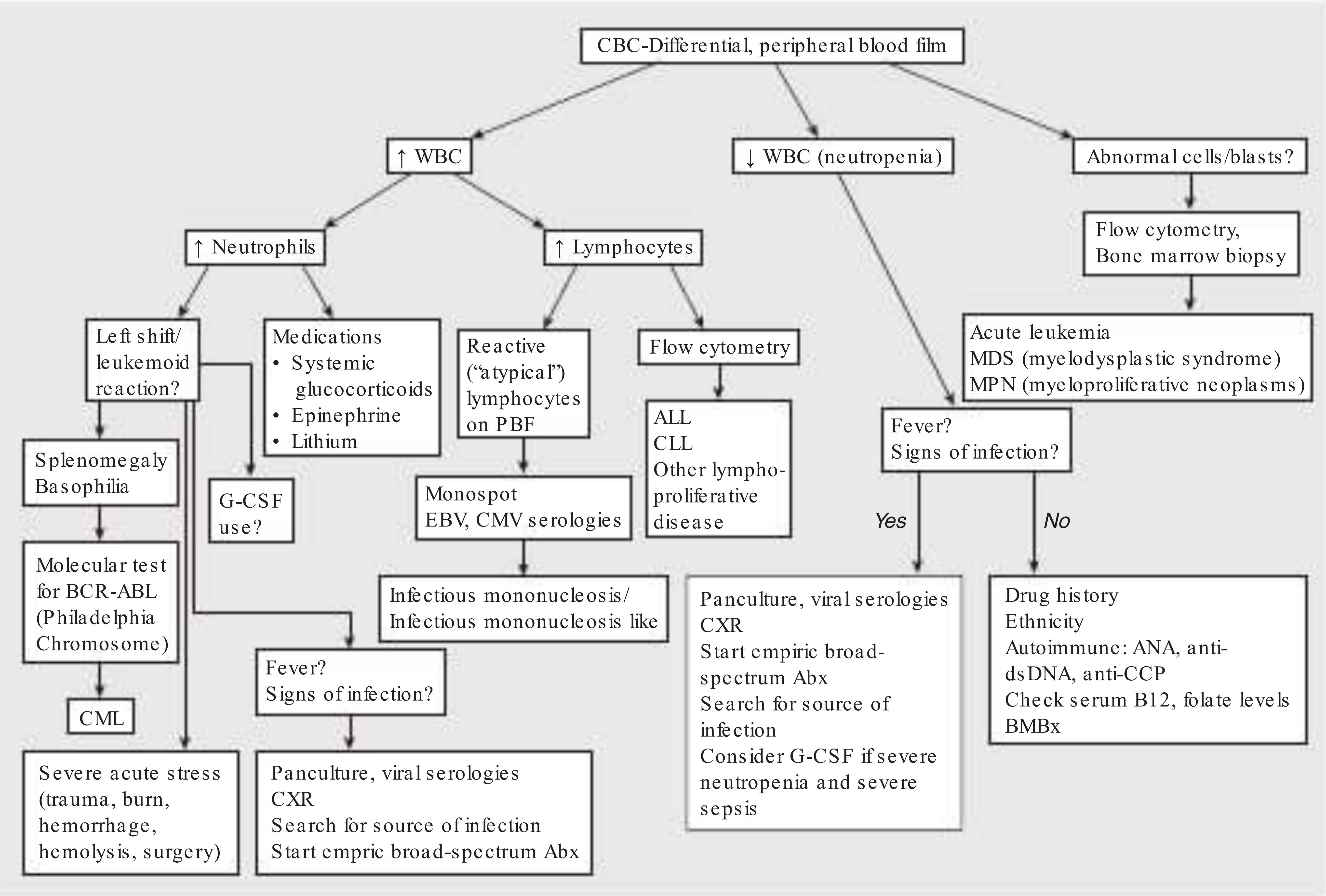

CBC-Differential, peripheral blood film
↑ WBC
↓ WBC (neutropenia)
Abnormal cells/blasts?
↑ Neutrophils
↑ Lymphocytes
Flow cytometry, Bone marrow biopsy
Acute leukemia
MDS (myelodysplastic syndrome)
MPN (myeloproliferative neoplasms)
Left shift/ leukemoid reaction?
Medications
• Systemic glucocorticoids
• Epinephrine
• Lithium
Reactive ("atypical") lymphocytes on PBF
Flow cytometry
ALL
CLL
Other lymphoproliferative disease
Fever? Signs of infection?
Yes
No
Splenomegaly
Basophilia
G-CSF use?
Monospot
EBV, CMV serologies
Molecular test for BCR-ABL (Philadelphia Chromosome)
Infectious mononucleosis/ Infectious mononucleosis like
Panculture, viral serologies
CXR
Start empiric broad-spectrum Abx
Search for source of infection
Consider G-CSF if severe neutropenia and severe sepsis
Drug history
Ethnicity
Autoimmune: ANA, anti-dsDNA, anti-CCP
Check serum B12, folate levels
BMBx
Fever? Signs of infection?
CML
Severe acute stress (trauma, burn, hemorrhage, hemolysis, surgery)
Panculture, viral serologies
CXR
Search for source of infection
Start empric broad-spectrum Abx

Figure 11.3. Approach to WBC abnormalities.

BLEEDING TENDENCY AND BRUISING

MCC OBJECTIVE

Based on Objective #15-1 (Bleeding Tendency and Bruising) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- **Primary hemostasis:** mainly involves platelets and vWF leading to the endpoint of platelet plug formation

- **Secondary hemostasis:** involves the coagulation cascade, ultimately resulting in fibrin crosslinking, leading to reinforcement and stabilization of the platelet plug
- Disruption of either 1° or 2° hemostasis can manifest as a bleeding tendency, and may be inherited or acquired

APPLIED SCIENTIFIC CONCEPT

- See Figure 11.4 for coagulation cascade

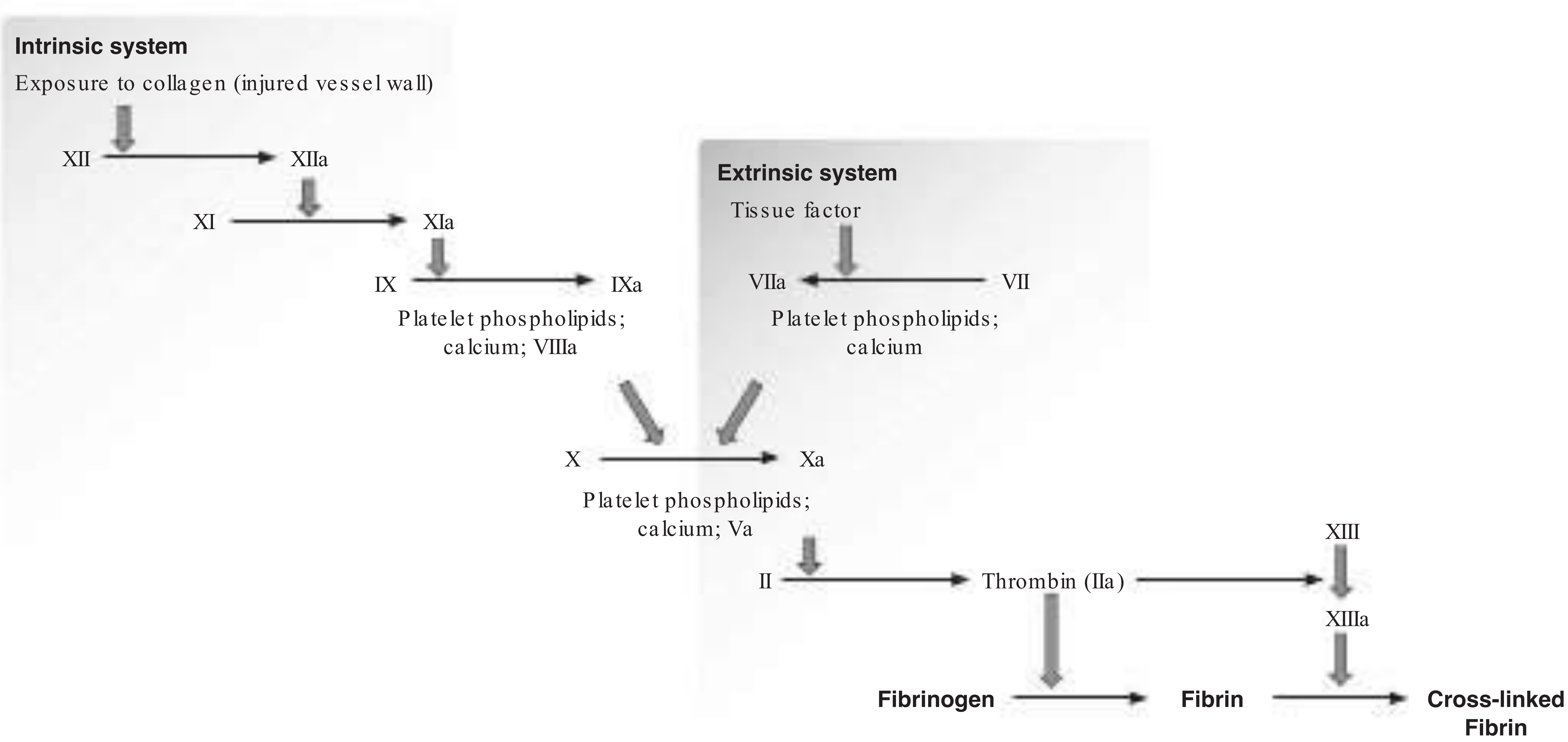

Intrinsic system
Exposure to collagen (injured vessel wall)
XII
XIIa
XI
XIa
IX
IXa
Platelet phospholipids; calcium; VIIIa
Extrinsic system
Tissue factor
VIIa
VII
Platelet phospholipids; calcium
X
Xa
Platelet phospholipids; calcium; Va
II
Thrombin (IIa)
XIII
XIIIa
Fibrinogen
Fibrin
Cross-linked Fibrin

Figure 11.4. Coagulation cascade.

CAUSAL CONDITIONS (Table 11.7)

The clinical history should consider likely etiologies:

1. Personal history of bleeding problems: petechiae/ecchymoses, epistaxis, gingival bleeding, menorrhagia, hematuria, GI bleed, hemarthrosis, muscle hematomas, bleeding outcomes following surgery/tooth extractions, transfusion history
2. Family history of bleeding diathesis
3. Medications: ASA, clopidogrel, NSAIDs, warfarin, heparin, dabigatran, rivaroxaban, antibiotics (induce Vit K deficiency by altering gut flora)

TABLE 11.7 • Causal conditions of hemostasis disorders

Disorders of 1° Hemostasis					Disorders of 2° Hemostasis
Vascular Response	Platelet Plug Formation				
	Quantitative Defects (Causes of Thrombocytopenia)				
	Decreased Production	Increased Destruction	Sequestration	Qualitative Defects	
• Hereditary hemorrhagic telangictasia (HHT) • Acquired (steroids, vasculitis)	• Marrow failure/infiltrate • Viral infections • Toxins (EtOH, chemo/RT) • B_{12}/folate deficiency	• Immune (ITP, drug induced, SLE) • Nonimmune (DIC, TTP, HUS, infection)	• Splenomegaly	• Inherited (vWD, Bernard-Soulier, Glanzmann's) • Acquired (ASA, NSAIDs, uremia, liver disease)	• Inherited (hemophilia A, hemophilia B) • Acquired (liver disease, Vit K deficiency, anticoagulants, factor inhibitors)

CLINICAL box

Comparison of Clinical Findings in Disorders of 1° versus 2° Hemostasis

	Disorder of 1° Hemostasis	Disorder of 2° Hemostasis
Site of bleeding	Mucocutaneous (epistaxis, gingival, menorrhagia, petechiae/ecchymoses)	Deep tissue (hemarthrosis, intramuscular hematoma)
Onset of bleeding after injury	Immediate	Delayed

AppROACh (Figure 11.5)

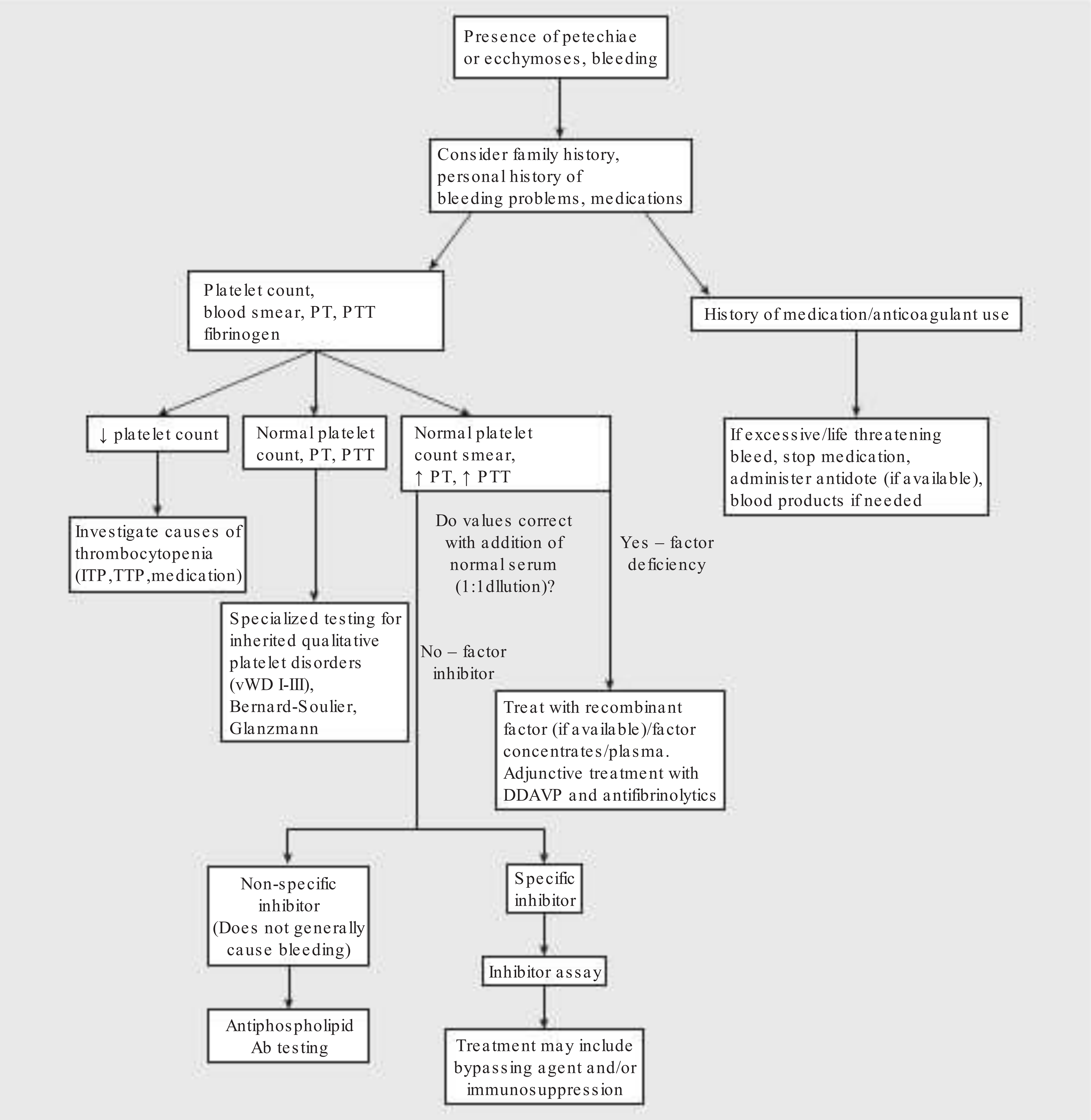

Presence of petechiae or ecchymoses, bleeding
Consider family history, personal history of bleeding problems, medications
Platelet count, blood smear, PT, PTT fibrinogen
History of medication/anticoagulant use
↓ platelet count
Normal platelet count, PT, PTT
Normal platelet count smear, ↑ PT, ↑ PTT
If excessive/life threatening bleed, stop medication, administer antidote (if available), blood products if needed
Investigate causes of thrombocytopenia (ITP,TTP,medication)
Do values correct with addition of normal serum (1:1dllution)?
Yes – factor deficiency
Specialized testing for inherited qualitative platelet disorders (vWD I-III), Bernard-Soulier, Glanzmann
No – factor inhibitor
Treat with recombinant factor (if available)/factor concentrates/plasma. Adjunctive treatment with DDAVP and antifibrinolytics
Non-specific inhibitor (Does not generally cause bleeding)
Specific inhibitor
Inhibitor assay
Antiphospholipid Ab testing
Treatment may include bypassing agent and/or immunosuppression

Figure 11.5. Approach to bleeding and bruising.

VENOUS THROMBOSIS, HYPERCOAGULABLE STATE

MCC OBJECTIVE

Based on Objective #15-2 (Venous Thrombosis, Hypercoagulable State) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- A propensity to developing venous thrombosis may arise from inherited or acquired conditions. In addition to treating acute thrombotic events, patient management involves preventing future thrombotic events.

CAUSAL CONDITIONS (Table 11.8)

TABLE 11.8 • Causal conditions for hypercoagulable state

Inherited	Thrombophilia (<50-yr-old)	• Antithrombin deficiency • Proteins C & S deficiency • Factor V Leiden (APC resistance) • Prothrombin 20210 mutation
Acquired disorders/ risk factors	Cellular elements (hypercoagulability)	• Malignancy • Pregnancy, OCP, HRT, tamoxifen • HIT, DIC, TTP • Other (antiphospholipid Ab syndrome, nephrotic syndrome, PNH)
	Vascular endothelium (injury)	• Surgery, trauma
	Circulatory (stasis)	• Pregnancy • Immobilization • Atrial fibrillation

CLINICAL box

Diagnostic Testing

1° Tests

- Compression U/S: gold standard in veins above the calf
- V/Q scan routinely used in suspected PE but not useful if parenchymal lung disease present
- Spiral CT commonly used in suspected PE but cannot be used in patients with compromised renal function or in pregnancy

2° Tests

- Contrast venography: if U/S not feasible/informative but difficult for patient
- MRI: accurate as venography but expensive, used for patients with pregnancy, poor renal function, or contrast agent allergy
- Pulmonary angiography: gold standard for PE but rarely used. Contraindicated if compromised renal function

CLINICAL box

Tests for Hemostasis

1°

- Platelet count
- Platelet function test

2°

- PTT—intrinsic pathway factors (VII, IX, XI, XII), monitors heparin Rx
- PT/INR—extrinsic pathway factor (VII), monitors warfarin Rx
- TT (Thrombin Time)—measures fibrinogen deficiency or ↓ prothrombin activation

CLINICAL box

PTT 1:1 Dilution

If PTT corrects with 1:1 dilution = absolute deficiency in factor level

If PTT remains high = factor inhibitor present

CLINICAL box

HIT with Subsequent Thrombosis

- Patient has Ab against the PF4–heparin complex.
- It leads to ↓ in platelet count (< 150,000/mm^3 or < 50% of baseline) and a 30-fold ↑ in risk of thrombosis.
- Discontinue heparin—cannot replace with LMWH (cross-reactivity) or warfarin (skin necrosis)
- Instead, switch to either direct thrombin inhibitors or heparinoid anticoagulation

APPROACH (Figure 11.6)

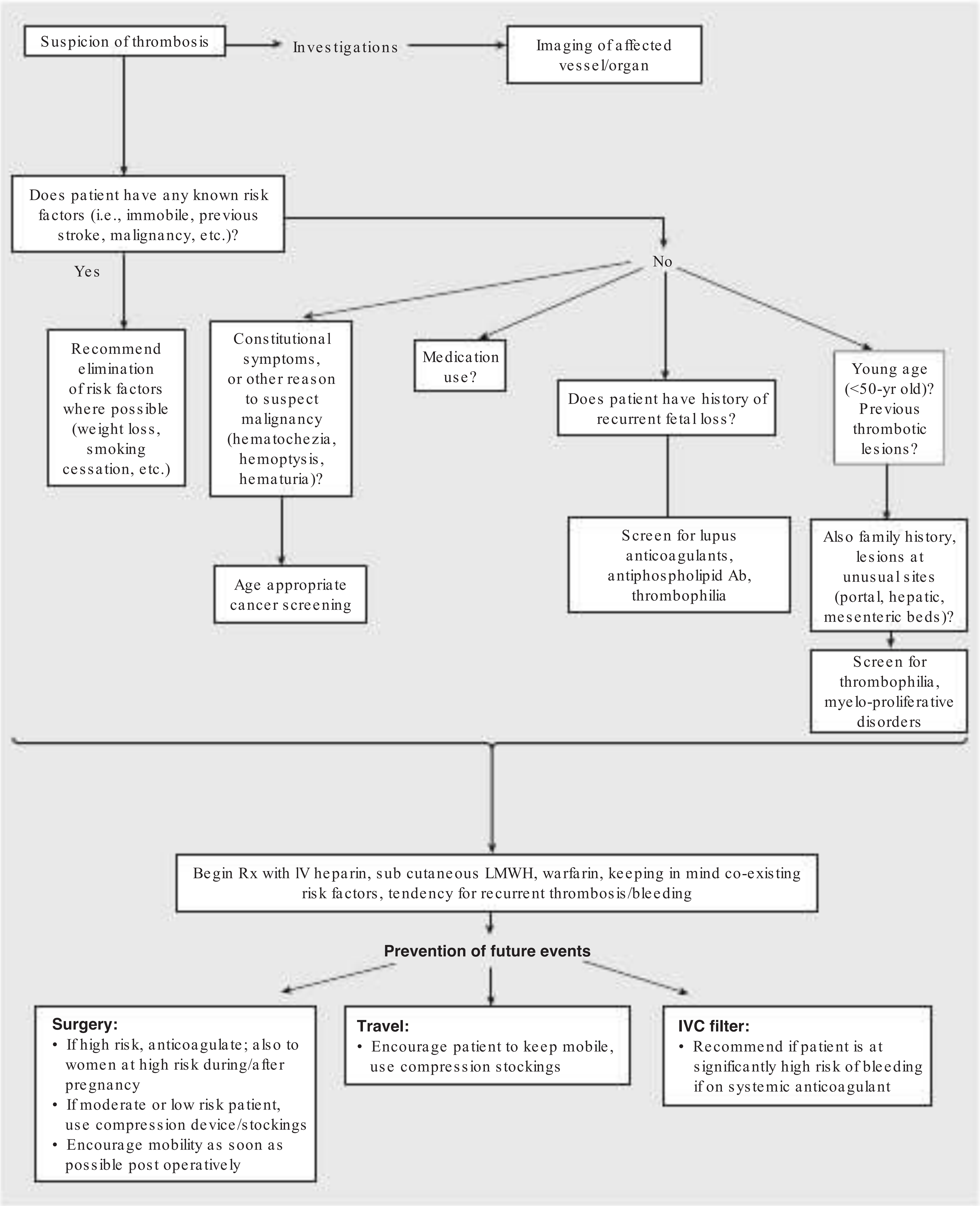

Suspicion of thrombosis
Investigations
Imaging of affected vessel/organ
Does patient have any known risk factors (i.e., immobile, previous stroke, malignancy, etc.)?
Yes
No
Recommend elimination of risk factors where possible (weight loss, smoking cessation, etc.)
Constitutional symptoms, or other reason to suspect malignancy (hematochezia, hemoptysis, hematuria)?
Age appropriate cancer screening
Medication use?
Does patient have history of recurrent fetal loss?
Screen for lupus anticoagulants, antiphospholipid Ab, thrombophilia
Young age (<50-yr old)? Previous thrombotic lesions?
Also family history, lesions at unusual sites (portal, hepatic, mesenteric beds)?
Screen for thrombophilia, myelo-proliferative disorders
Begin Rx with IV heparin, sub cutaneous LMWH, warfarin, keeping in mind co-existing risk factors, tendency for recurrent thrombosis/bleeding
Prevention of future events
Surgery:
• If high risk, anticoagulate; also to women at high risk during/after pregnancy
• If moderate or low risk patient, use compression device/stockings
• Encourage mobility as soon as possible post operatively
Travel:
• Encourage patient to keep mobile, use compression stockings
IVC filter:
• Recommend if patient is at significantly high risk of bleeding if on systemic anticoagulant

Figure 11.6. Approach to hypercoagulability states.

SPLENOMEGALY

MCC OBJECTIVE

Based on Objective #2-3 (Splenomegaly) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- An enlarged spleen is usually a manifestation of an underlying disease, rather than 1° splenic disease.

CAUSAL CONDITIONS (Table 11.9)

APPROACH (Figure 11.7)

TABLE 11.9 • Causal conditions of splenomegaly

Demand for increased splenic function	Clearance of abnormal RBC	• Thalassemia major • Abnormalities of RBC shape (hereditary spherocytosis/elliptocytosis)
	Infection	• Bacterial (SBE, sepsis, TB) • Viral (infectious mononucleosis, hepatitis) • Fungal (Histoplasma) • Parasitic (malaria, leishmania)
	Autoimmune	• RA (Felty syndrome) • SLE • Collagen vascular disease • Drug reactions
Altered splenic circulation	• Cirrhosis, portal hypertension • Portal vein obstruction, hepatic vein obstruction • Splenic vein obstruction • CHF	
Splenic infiltration	• Myeloproliferative disorders • Malignancy (leukemia, lymphoma, metastatic solid tumor) • Amyloidosis • Sarcoidosis • Storage diseases (Gaucher, Niemann-Pick)	

CLINICAL box

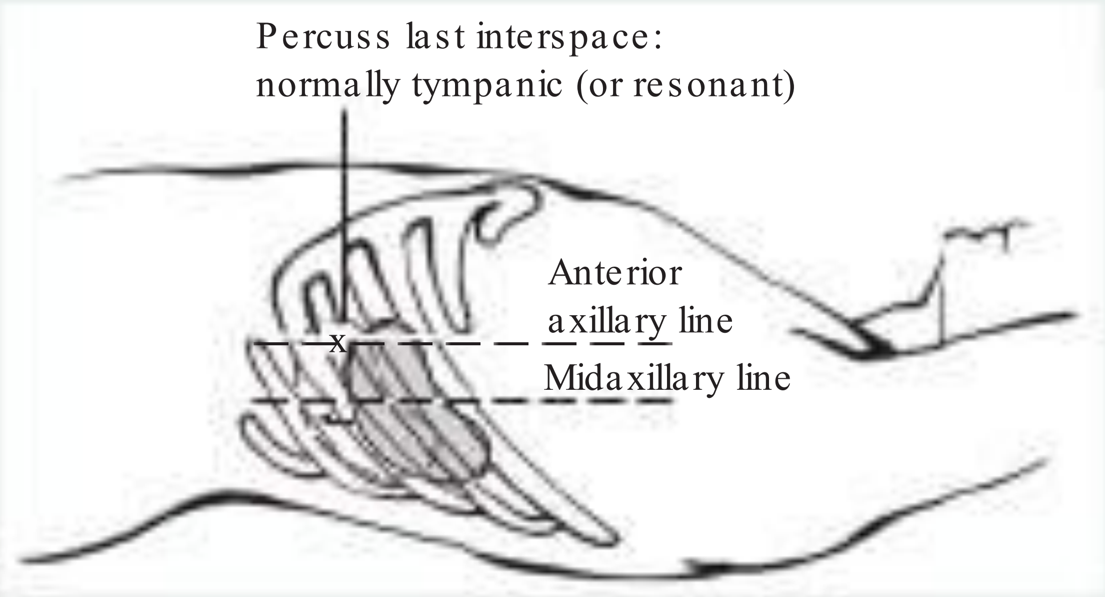
Major Causes of Splenomegaly

ICE MASS

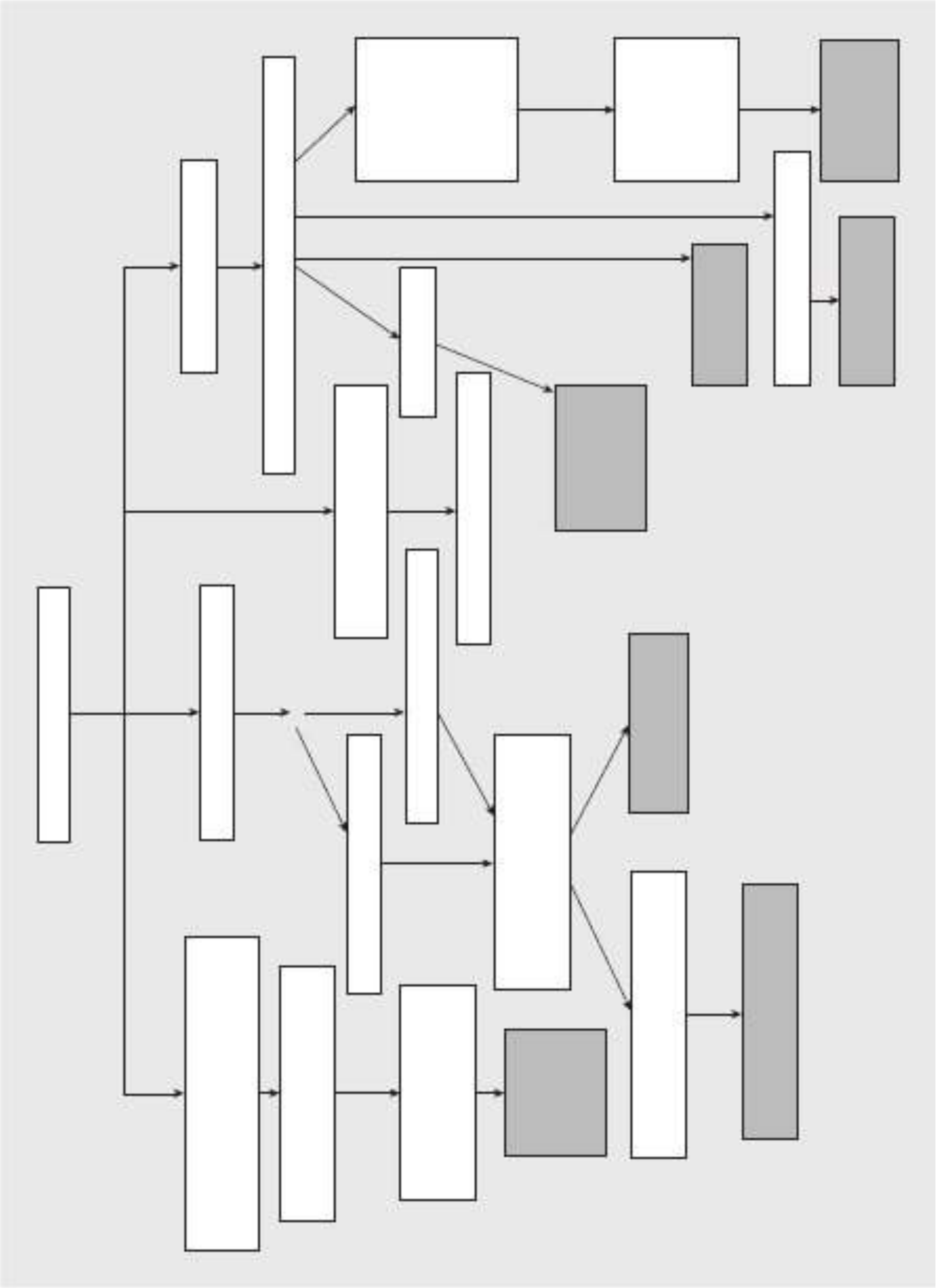
- Infectious
- Congestive splenomegaly
- Chronic liver disease
- Extramedullary hematopoiesis
- Malignancy
- Amyloidosis
- Sarcoidosis, Storage disease

CLINICAL box

Dx of Splenomegaly on Exam



Castell method: if the spleen is normal, percussion in the lowest intercostal space (eighth to ninth) in the left anterior axillary line of the supine patient elicits a resonant note throughout the respiratory cycle. If percussion on full inspiration produces a dull note (Castell sign), this is suggestive of splenic enlargement.



CLINICAL box

Features That Differentiate Spleen from Kidney on Physical Exam

	Spleen	Kidney
Notch	Anteromedial aspect	None
Direction of enlargement and movement on inspiration	Inferomedially toward the RLQ, crossing midline	Inferiorly; does not cross midline
Percussion note below costal margin	Dull	Usually resonant (overlying bowel)
Upper border	Not palpable	Palpable
Ballotable	No	Yes
Splenic rub	Yes	No

CLINICAL box

Iron-deficiency anemia always requires investigation into underlying cause—↓ intake versus ↓ absorption versus blood loss

CLINICAL box

A finding of iron-deficiency anemia requires investigation of its underlying cause (decreased intake vs. decreased absorption vs. blood loss). In postmenopausal women, and men >50 yr, it is important to rule out occult GI blood loss from an underlying malignancy.

ANEMIA

MCC OBJECTIVE

Based on Objective #42-1 (Anemia) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- A decrease in the number of circulating RBC can result from processes leading to decreased RBC production, increased RBC destruction, or from blood loss.
- Additionally, approaching anemia from a morphologic standpoint, taking into account the MCV, can help focus investigations in order to delineate the underlying etiology.

APPLIED SCIENTIFIC CONCEPT

- Vit B_{12} (cobalamin) metabolism and absorption.
  - Cobalamin–protein complex from diet enters stomach.
  - Stomach acid releases cobalamin from protein.
    - Cobalamin binds to R-proteins (from parietal cells).
  - In duodenum, pancreatic enzymes release cobalamin from R-protein.
  - Cobalamin then binds to intrinsic factor (IF) and travels to terminal ileum.
  - Cobalamin–IF complex binds to cubuilin (receptor expressed by mucosal cells in ileum) → endocytosed.
    - Cobalamin then binds to transport proteins (transcobalamin [TC] II) for delivery to cells.
  - TCII–cobalamin complex is endocytosed; cobalamin released and converted to coenzyme forms.

CLINICAL box

Neurologic Findings in B_{12} Deficiency

- Dementia
- Peripheral neuropathy (especially of lower limbs)
- Subacute combined degeneration: affects corticospinal tract (spasticity, hyperreflexia) and dorsal column (decreased proprioception and vibration sense)

TABLE 11.10 • Megaloblastic anemia—caused by Vit B_{12} or folate deficiency

Causes of Folate Deficiency	Causes of Vit B12 Deficiency
• Decreased intake: • Lack of leafy green vegetables in diet (e.g., alcoholism, poverty) • Decreased absorption: • Celiac disease • Crohn disease • Extensive small bowel resection • Other: • Drugs—anticonvulsants, antifolates (methotrexate) • Increased requirements/loss: ○ Hemolysis ○ Pregnancy ○ Hemodialysis ○ Psoriasis, exfoliative dermatitis	• Decreased intake: • Strict vegans; infants breastfed by B_{12}-deficient or vegan mothers • Altered metabolism: • Pernicious anemia (antibodies to parietal cells or intrinsic factor) • Achlorhydria (acid required to release cobalamin from protein-bound state) • H_2 blockers (decreased IF secretion) • Postgastrectomy • Pancreatic insufficiency (cannot digest R-binders off cobalamin) • Decreased absorption: • Ileal disease (Crohn disease)/ileal resection • Celiac disease • Pancreatic insufficiency (cannot digest R-binders off B_{12})

CLINICAL box

Iron Studies—Iron-Deficiency Anemia versus Anemia of Chronic Disease

	Iron Deficiency	Anemia of Chronic Disease
Ferritin	↓↓	↑/N
Serum iron	↓/N	↓/N
TIBC	↑/high N	↓/low N
% Saturation	↓↓	↓

CAUSAL CONDITIONS (Table 11.11)

TABLE 11.11 • Causal conditions of anemia

	Normocytic (MCV 80–100 fL)		
Microcytic (MCV , 80 fL)	Low/Normal Reticulocytes	High Reticulocytes	Macrocytic (MCV . 100 fL)
Iron deficiency	Anemia of chronic disease	Acute blood loss	Megaloblastic (B_{12}/folate deficiency, drugs)
Thalassemia	Renal failure	Hemolysis	Liver disease
Anemia of chronic disease	Combined iron and B_{12}/folate deficiency	Splenic sequestration	Alcohol
Lead poisoning	Marrow infiltration		MDS
Sideroblastic anemia	Aplastic anemia		Hypothyroidism
			Reticulocytosis (in response to hemorrhage or hemolysis)

APPROACH (Figure 11.8)

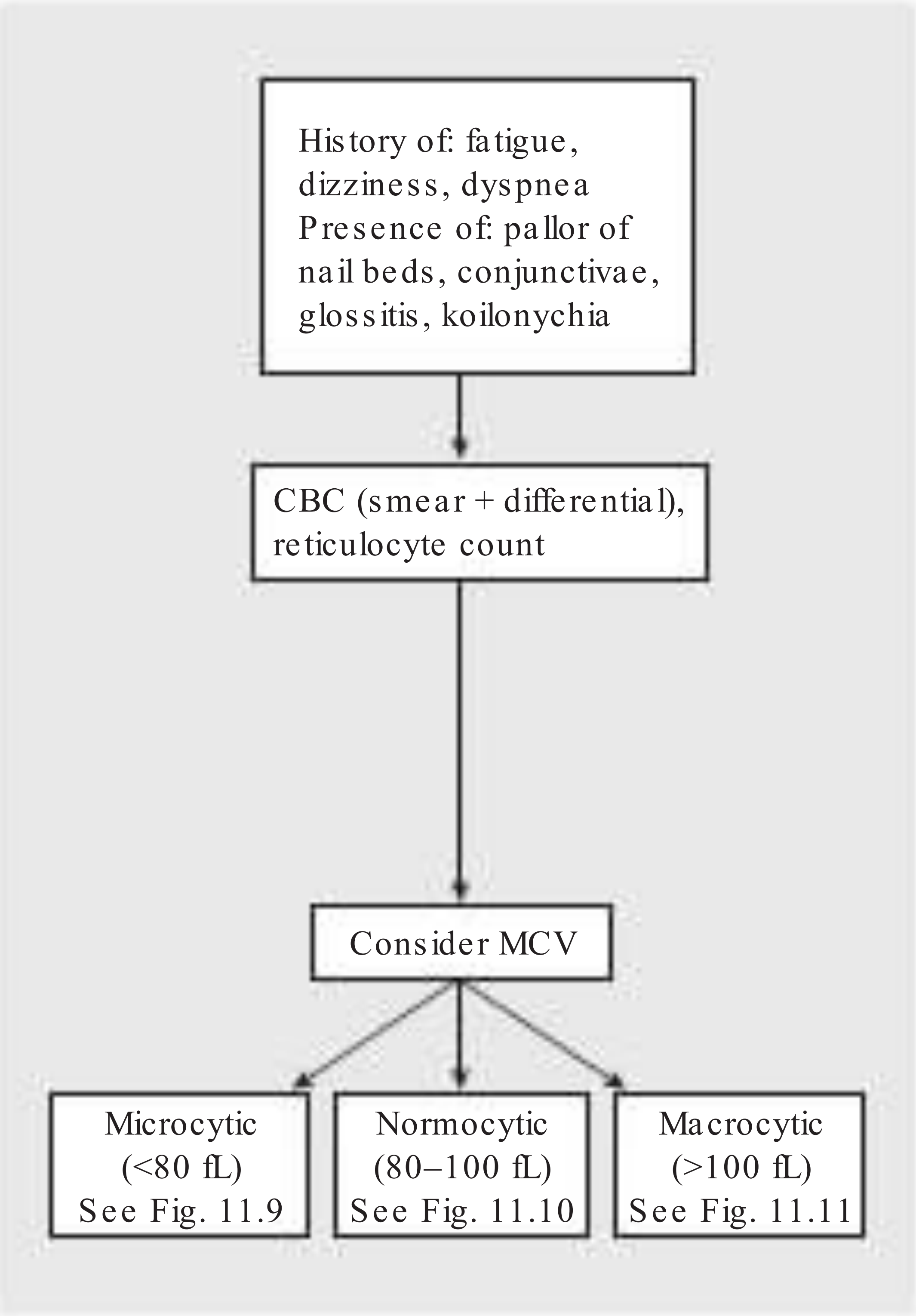

History of: fatigue, dizziness, dyspnea
Presence of: pallor of nail beds, conjunctivae, glossitis, koilonychia
CBC (smear + differential), reticulocyte count
Consider MCV
Microcytic (<80 fL) See Fig. 11.9
Normocytic (80–100 fL) See Fig. 11.10
Macrocytic (>100 fL) See Fig. 11.11

Figure 11.8. Approach to anemia.

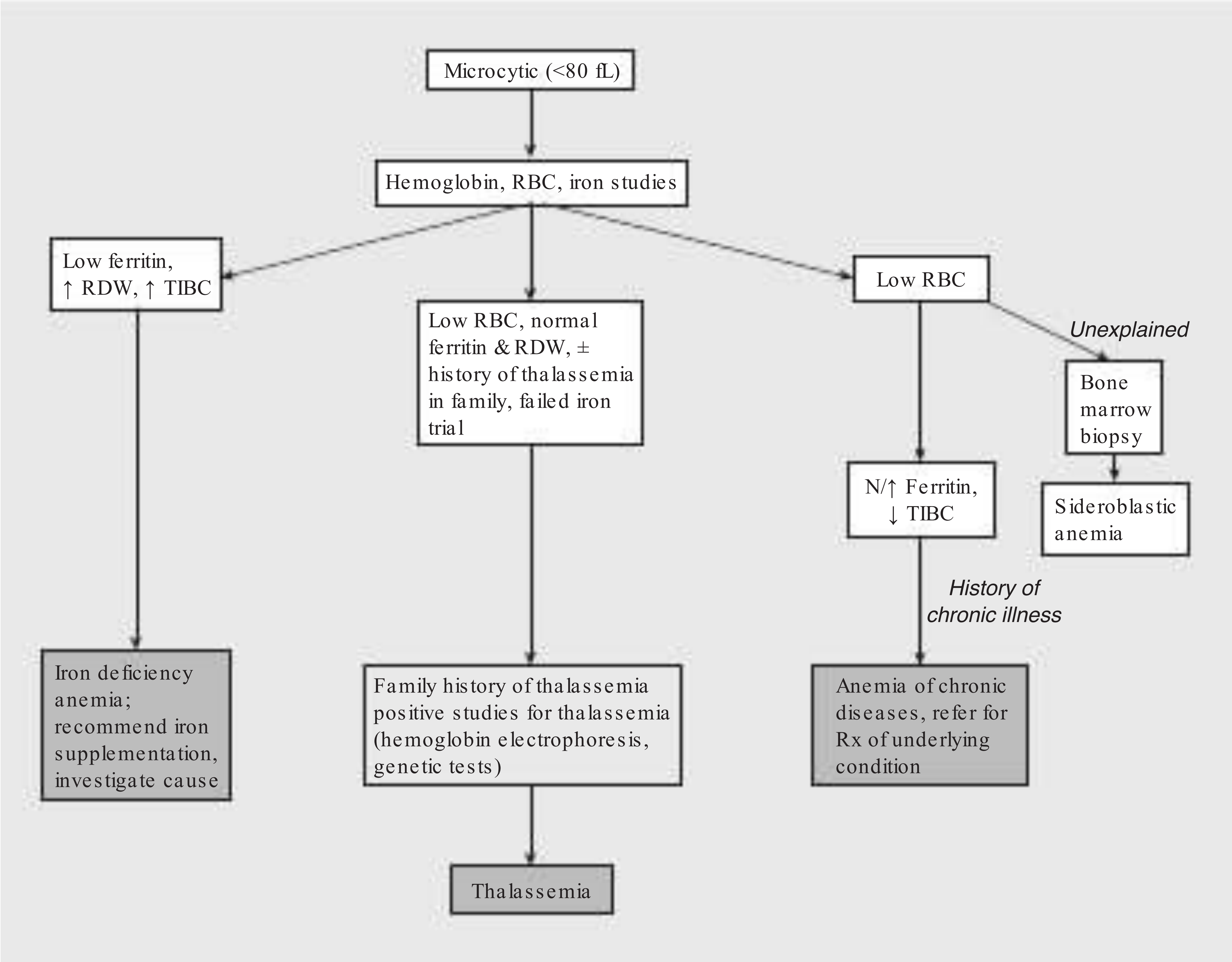
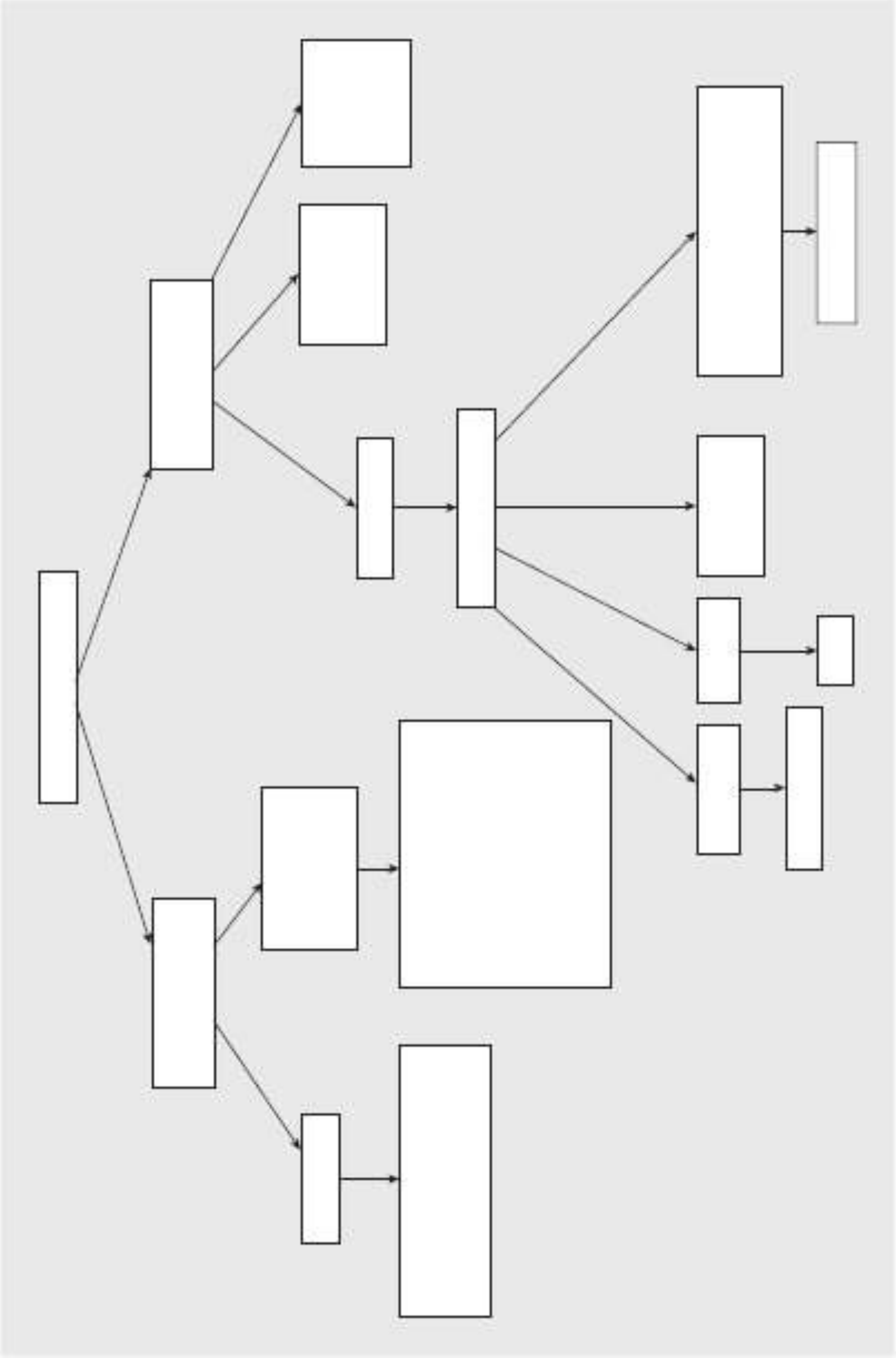

Microcytic (<80 fL)
Hemoglobin, RBC, iron studies
Low ferritin, ↑ RDW, ↑ TIBC
Low RBC, normal ferritin & RDW, ± history of thalassemia in family, failed iron trial
Low RBC
Unexplained
Bone marrow biopsy
N/↑ Ferritin, ↓ TIBC
Sideroblastic anemia
History of chronic illness
Iron deficiency anemia; recommend iron supplementation, investigate cause
Family history of thalassemia positive studies for thalassemia (hemoglobin electrophoresis, genetic tests)
Anemia of chronic diseases, refer for Rx of underlying condition
Thalassemia

Figure 11.9. Approach to microcytic anemia.



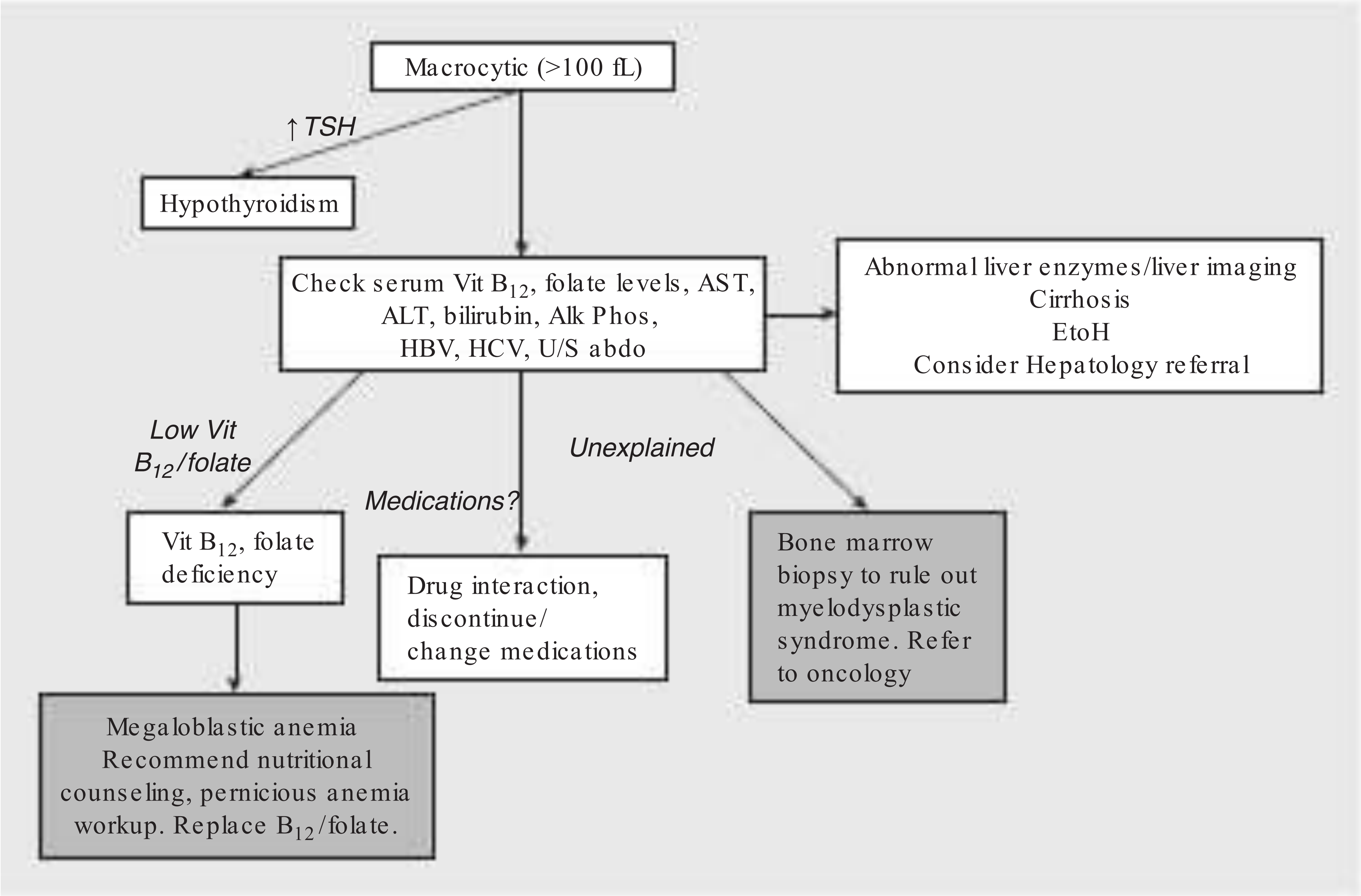

Macrocytic (>100 fL)
↑TSH
Hypothyroidism
Check serum Vit B12, folate levels, AST, ALT, bilirubin, Alk Phos, HBV, HCV, U/S abdo
Abnormal liver enzymes/liver imaging
Cirrhosis
EtoH
Consider Hepatology referral
Low Vit B12/folate
Medications?
Unexplained
Vit B12, folate deficiency
Drug interaction, discontinue/ change medications
Bone marrow biopsy to rule out myelodysplastic syndrome. Refer to oncology
Megaloblastic anemia
Recommend nutritional counseling, pernicious anemia workup. Replace B12/folate.

Figure 11.11. Approach to macrocytic anemia.

POLYCYTHEMIA / ELEVATED HEMOGLOBIN

CLINICAL box

Characteristics of polycythemia vera:

- Median age of diagnosis 60 yr
- Venous and arterial thrombosis in unusual sites (e.g., mesenteric/ portal/splenic vein, Budd-Chiari syndrome)
- Headache
- Blurry vision
- Erythromelalgia
- Gouty arthritis
- Pruritus
- Splenomegaly
- Easy bleeding (GI bleed, epistaxis)

MCC OBJECTIVE

Based on Objective #42-2 (Elevated Hemoglobin) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- An increase in hemoglobin may be reflective of an increased RBC mass or a decrease in plasma volume.

APPLIED SCIENTIFIC CONCEPT

- An absolute increase in RBC mass (true polycythemia) may be due to independent marrow overproduction of RBC (polycythemia vera) or 2° to elevated EPO levels.
- Hemoglobin and hematocrit measure the ratio of RBC mass to plasma volume; therefore, they are sensitive to changes in either one.
- Determination of polycythemia must be based on direct assessment of RBC mass and plasma volume. "True" polycythemia involves an absolute ↑ of RBC mass, whereas "relative" polycythemia (Gaisböck) is a ↓ in volume.

CAUSAL CONDITIONS (Table 11.12)

Table 11.12 • Causal conditions of polycythemia

True Polycythemia			
Appropriately Increased EPO	Inappropriately Increased EPO	Decreased EPO	Relative Polycythemia
• Hypoxia (COPD, congenital cyanotic heart disease) • Obstructive sleep apnea • Smoking • High altitudes • High-affinity hemoglobins	• Renal pathology (renal artery stenosis, PCKD) • EPO-secreting tumor (RCC, HCC) • Uterine fibroids • Cerebellar hemangioma	• Polycythemia vera	• Decreased plasma volume (diarrhea, diuretics, burns)

CLINICAL box

WHO 2008 Diagnostic Criteria for Polycythemia Vera[a]

- Diagnosis requires the presence of either:
  - Both major criteria and one minor criterion, or
  - First major criterion and two minor criteria
- Major criteria:
  - Elevated hemoglobin: Hb > 185 g/L (males) or > 165 g/L (females)
  - Presence of JAK2 mutation
- Minor criteria:
  - Hypercellular bone marrow with trilineage myeloproliferation (panmyelosis)
  - Decreased serum erythropoietin level
  - Endogenous erythroid colony growth *in vitro*

---

[a] Swerdlow SH, Campo E, Harris NL, et al. *WHO Classification of Tumours of Haematopoietic and Lymphoid Tissues.* Lyon, France: IARC; 2008.

ASC box

EPO

Stimulation: ↓ in oxygenation of blood

Production: peritubular kidney cells

Action: bone marrow, ↑ RBC production

APPROACH (Figure 11.12)

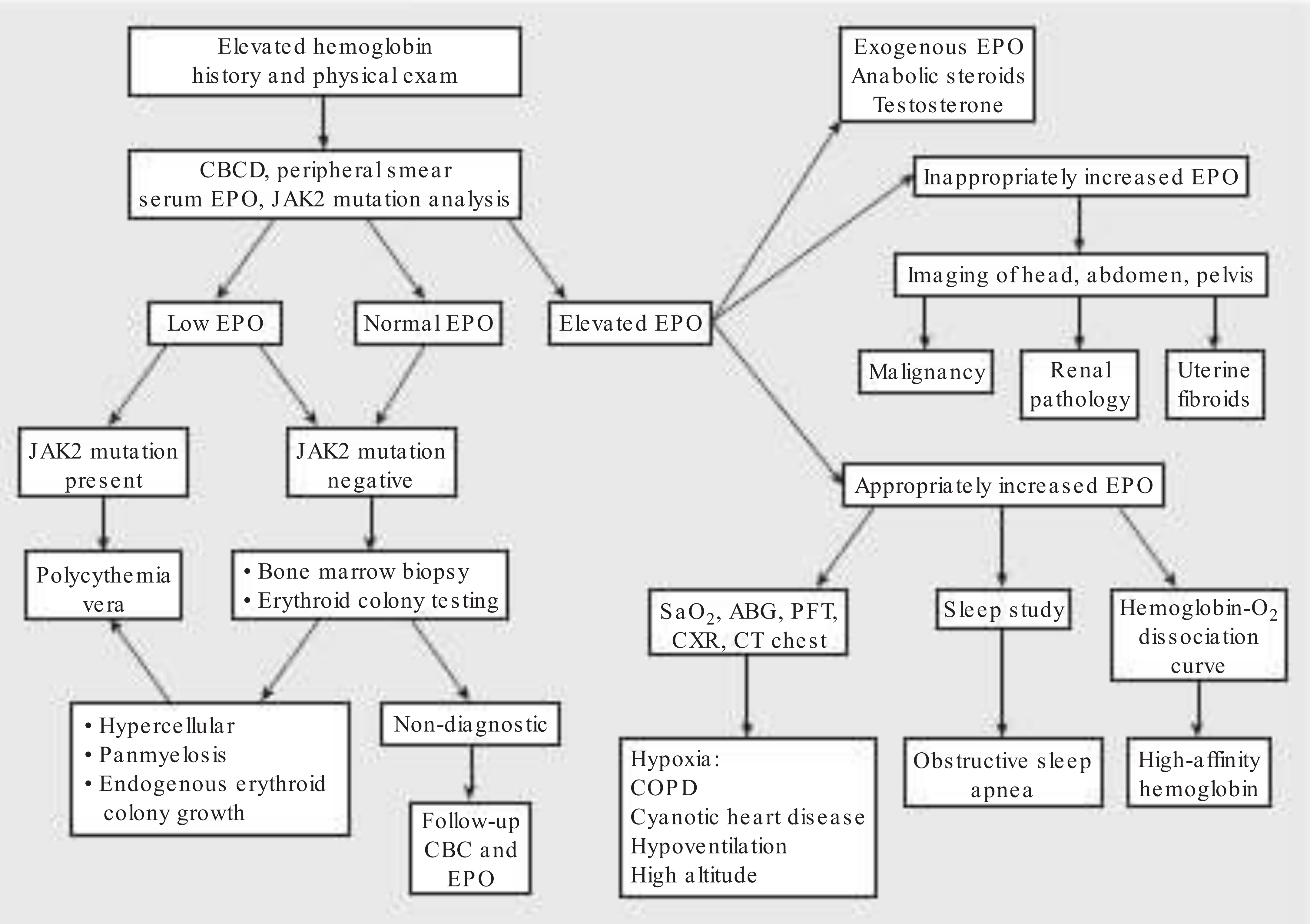

Elevated hemoglobin history and physical exam
CBCD, peripheral smear serum EPO, JAK2 mutation analysis
Low EPO
Normal EPO
Elevated EPO
JAK2 mutation present
JAK2 mutation negative
Polycythemia vera
• Bone marrow biopsy • Erythroid colony testing
• Hypercellular • Panmyelosis • Endogenous erythroid colony growth
Non-diagnostic
Follow-up CBC and EPO
Exogenous EPO Anabolic steroids Testosterone
Inappropriately increased EPO
Imaging of head, abdomen, pelvis
Malignancy
Renal pathology
Uterine fibroids
Appropriately increased EPO
SaO2, ABG, PFT, CXR, CT chest
Sleep study
Hemoglobin-O2 dissociation curve
Hypoxia: COPD Cyanotic heart disease Hypoventilation High altitude
Obstructive sleep apnea
High-affinity hemoglobin

Figure 11.12. Approach to polycythemia.

LYMPHADENOPATHY

MCC OBJECTIVE

Based on Objective #54 (Lymphadenopathy) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- **Enlarged lymph nodes . 1 cm are abnormal.**
- Lymphadenopathy may represent a 1° **pathologic process of the lymph nodes, or a** reactive/2° **manifestation of other disorders.**

APPLIED SCIENTIFIC CONCEPT

- Lymphatic system consists of lymph nodes (Figure 11.13) and vessels, as well as the thymus, spleen, and Peyer patches in the gut.
- Simplified schematic of immune system (Figure 11.14).

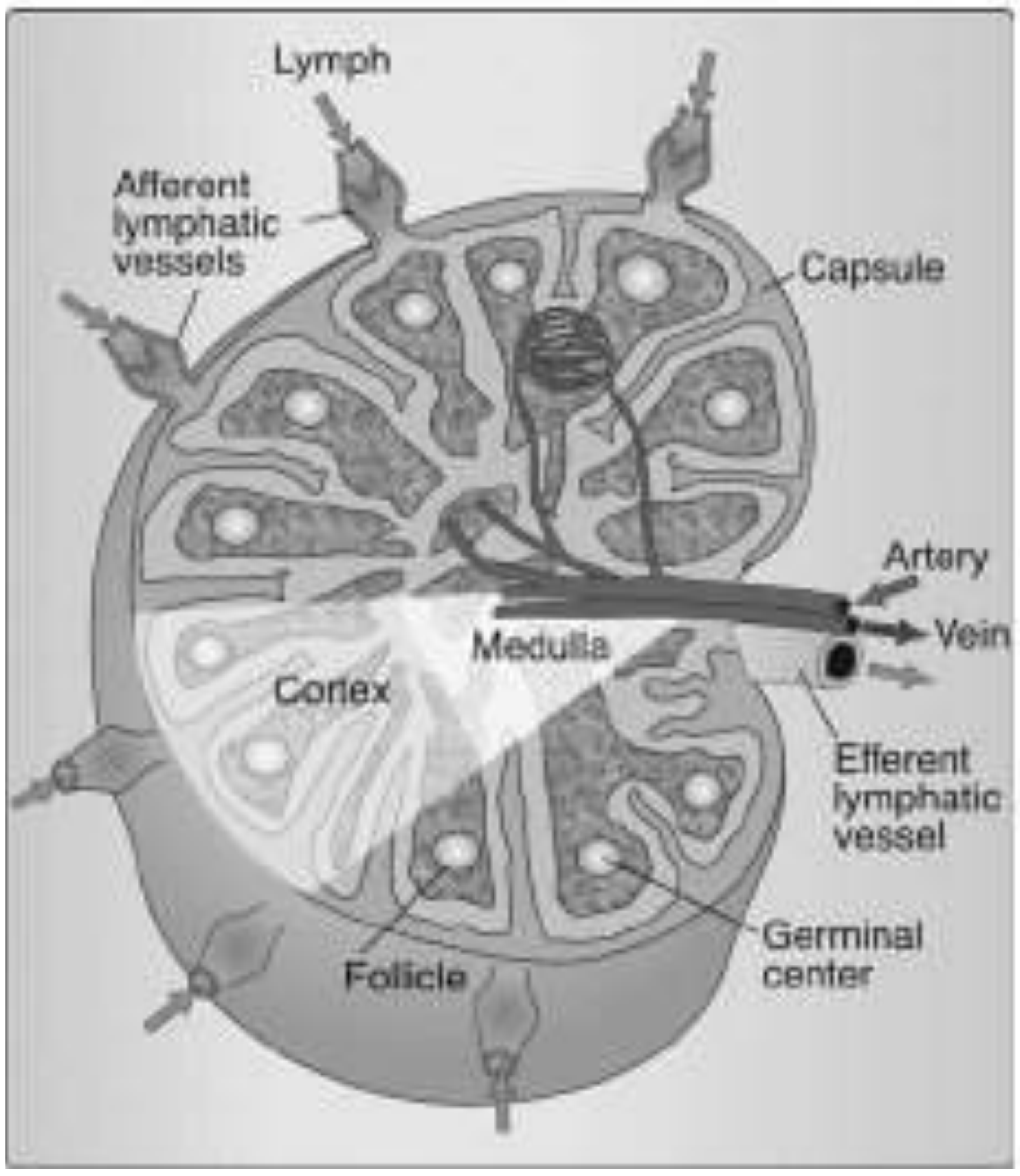


Figure 11.13. Anatomy of a normal lymph node. (Modified from Doan T, Melvold R, Viselli S, et al. Immunology. 2nd ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2012.)

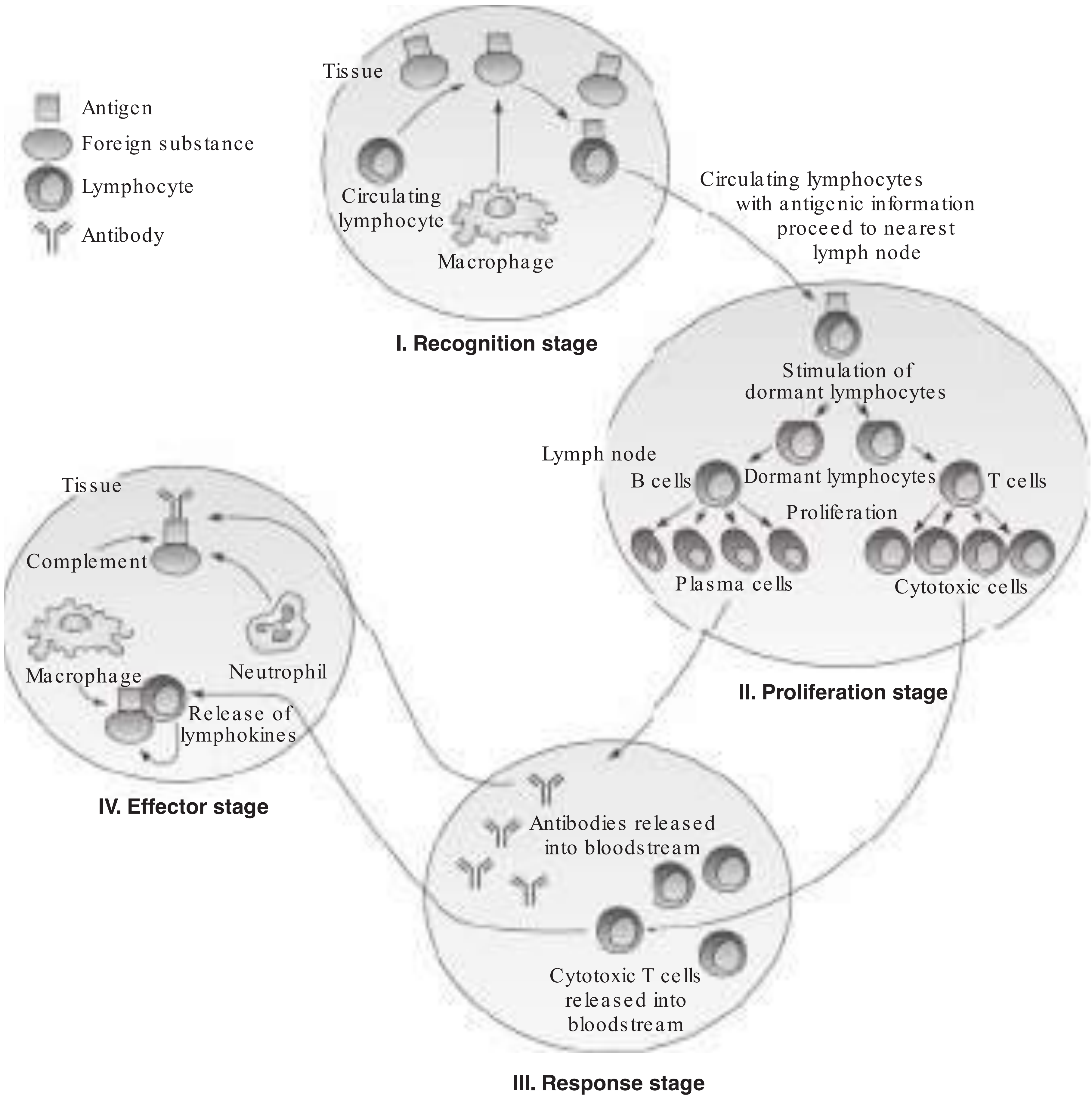


Figure 11.14. Activation of adaptive immunity consists of four stages. Recognition stage: Antigens are recognized by circulating lymphocytes and macrophages. Proliferation stage: Dormant lymphocytes proliferate and differentiate into cytotoxic (killer) T cells or B cells responsible for formation and release of antibodies. Response stage: Cytotoxic T cells and B cells perform cellular and humoral functions, respectively. Effector stage: Antigens are destroyed or neutralized through the action of antibodies, complement, macrophages, and cytotoxic T cells. (From Smeltzer SC, Bare BG. Textbook of Medical-Surgical Nursing. 9th ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2000.)

CAUSAL CONDITIONS (Table 11.13)

TABLE 11.13 • Causal conditions of lymphadenopathy

Infectious	• Viral: EBV, CMV, HIV, infectious hepatitis, HSV • Bacterial: pyogenic bacteria, TB, syphilis • Fungal: histoplasmosis, coccidioidomycosis • Parasitic: toxoplasmosis
Malignancy	• Lymphoma • Leukemia • Metastatic CA
Immunologic/inflammatory	• Serum sickness • Collagen vascular disease: RA, Still disease, SLE, dermatomyositis, Sjogren syndrome • Drug hypersensitivity: phenytoin, hydralazine, allopurinol
Other	• Sarcoidosis • Amyloidosis • Endocrine: hyperthyroidism • Storage disease: Gaucher, Niemann-Pick

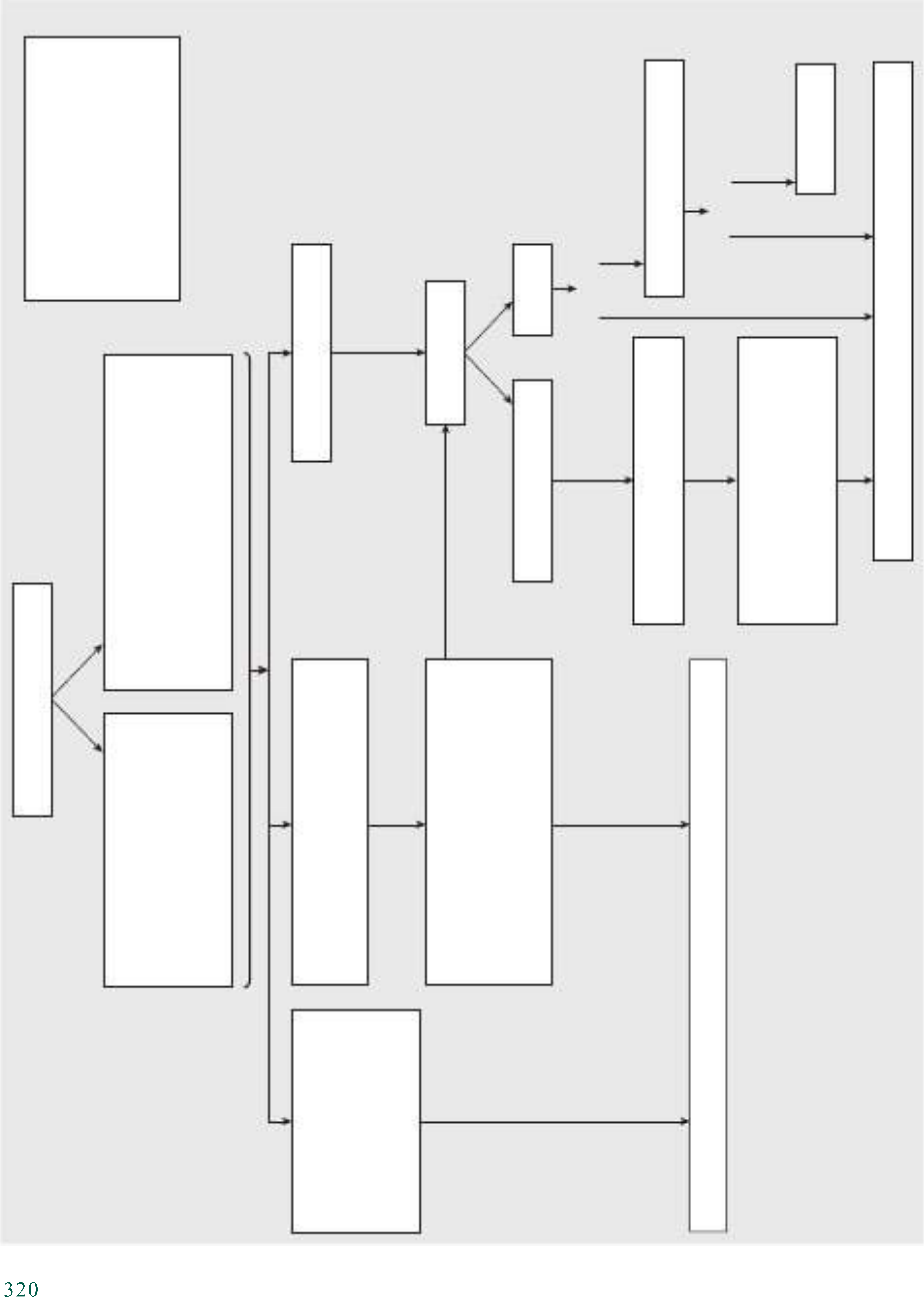
APPROACH (Figure 11.15)

CLINICAL box

Characteristics of Lymph Nodes on Physical Exam

Characteristics of lymph nodes may be suggestive of the underlying disease process:

- Normal: soft, discrete, mobile
- Inflammation: tender, mobile
- Lymphoma: large, rubbery, nontender, mobile
- Metastatic CA: hard, nontender, matted, nonmobile



CHAPTER

12

Nephrology

Valerie A. Luyckx • Alan W. McMahon • Magdalena Michalska

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Chronic Renal Failure
Hematuria
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Hypercalcemia
Hypocalcemia
Hyperphosphatemia
Hypophosphatemia

ACID–BASE DISTURBANCES

MCC OBJECTIVE

Based on Objective #45 (Acid–Base Abnormalities Hydrogen) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Definitions (Table 12.1)

TABLE 12.1 • Acid–base definitions

Acidemia	An increased concentration of hydrogen ions in the blood (pH falls below 7.35)
Acidosis	A condition increasing hydrogen ion concentration of arterial blood plasma (acidemia). Occurs when pH of the blood falls below 7.35
Alkalemia	Lower concentration of hydrogen ions in the blood (pH rises above 7.45)
Alkalosis	A condition reducing hydrogen ion concentration of arterial blood plasma (alkalemia). Occurs when pH of the blood exceeds 7.45

Rationale

- Acid–base disorders are encountered relatively frequently.
- Acidemia may be life-threatening.
- Several acid–base abnormalities can coexist in a single patient.
- Each disorder should be treated individually.

APPROACH

1. **Are the numbers correct?**
   - Use Henderson equation

$$(H^+)\ (\text{mEq/L}) = \frac{24 \times \text{Pco}_2\ (\text{mm Hg})}{(\text{Hco}_3)\ (\text{mEq/L})}$$

Correlation of pH with hydrogen concentration (Table 12.2)

TABLE 12.2 • Correlation of pH with hydrogen concentration

pH	7.55	7.50	7.45	7.40	7.35	7.30	7.25	7.20	7.15	7.10	7.05	7.00	6.95	6.90
(H^+)	28	32	35	40	45	50	56	63	71	79	89	100	112	126

2. **What is the type of acid–base disorder?** (Figure 12.1)

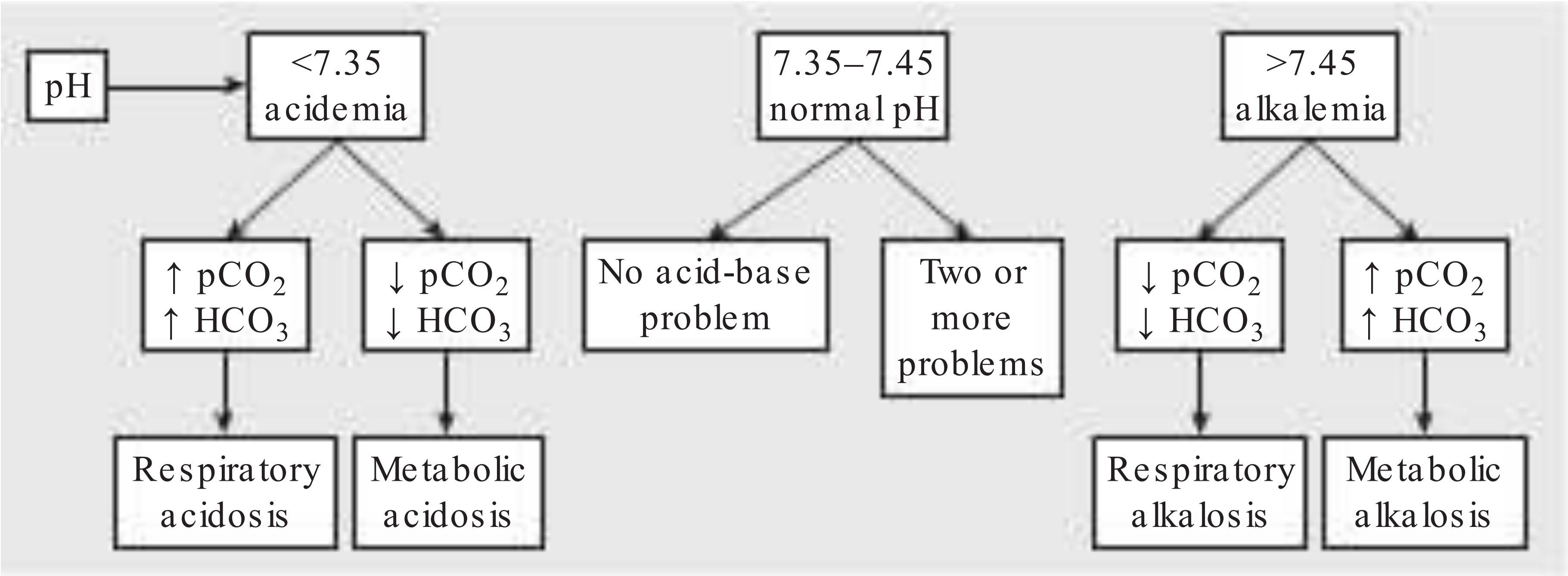


Figure 12.1. Basic categorization of acid–base disorders.

3. **Is an appropriate compensatory response present?** (Table 12.3)

TABLE 12.3 • Appropriate compensatory responses

Metabolic acidosis	↓ HCO_3 by 1 mmol/L	↓ PCO_2 by 1.25 mm Hg
Metabolic alkalosis	↑ HCO_3 by 1 mmol/L	↑ PCO_2 by 0.2–0.9 mm Hg
Acute respiratory acidosis	↑ PCO_2 by 10 mm Hg	↑ HCO_3 by 1 mmol/L
Acute respiratory alkalosis	↓ PCO_2 by 10 mm Hg	↓ HCO_3 by 2.5 mmol/L
Chronic respiratory acidosis	↑ PCO_2 by 10 mm Hg	↑ HCO_3 by 5 mmol/L
Chronic respiratory alkalosis	↓ PCO_2 by 10 mm Hg	↓ HCO_3 by 5 mmol/L

4. **What is the AG?**

$$AG = Na^+ - Cl^- - HCO_3^-$$

Normal range is 8 to 14 mEq/L

- Anion gap is increased in AG metabolic acidosis.
- Always calculate AG to make sure there is no mixed disorder.
- AG decreases by 4 mmol/L for each drop of albumin by 10 g/L.

5. **Calculate Dgap:**
   - Calculate Dgap to determine if second metabolic disturbance is present:

$$DHCO_3^- = 24 - HCO_3^-$$

$$DAG = \text{Calculated} - \text{Normal (12)}$$

CLINICAL box

$DHCO_3^- > DAG$—simultaneous non-AG metabolic acidosis

$DAG > DHCO_3^-$—simultaneous metabolic alkalosis

$DAG = DHCO_3^-$—only AG metabolic acidosis

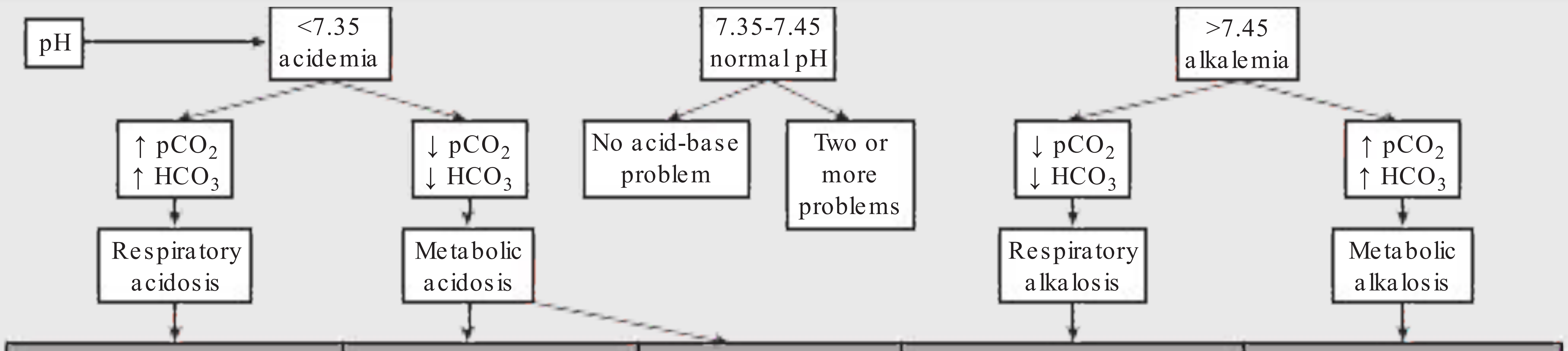
6. **Once you figured out which disorder is present try to establish etiology of each of them**

DIFFERENTIAL DIAGNOSIS/CAUSAL CONDITIONS (Figure 12.2)

Approach to Metabolic Alkalosis (Figure 12.3)

APPLIED SCIENTIFIC CONCEPTS

- **Renal excretion of acid is achieved by combining hydrogen ions:**
  - With urinary buffers to form titrable acid, mainly phosphate or
  - With ammonia to form ammonium
- **Urinary [Na^+] versus [Cl^-] as a surrogate for volume status**
  - Usually, changes in volume status cause similar changes in both renal Na^+ and Cl^- excretion.
  - With metabolic alkalosis, Na^+ is excreted in excess alongside HCO_3^- and Cl^- is better surrogate for volume status.
  - With metabolic acidosis, Cl^- is excreted in excess alongside NH_4^+ and Na^+ is a better surrogate for volume status.
- **Low Anion Gap:**
  - Can be seen with MM, lithium or bromide intoxication, or hypoalbuminemia



CNS:	**AC metabolic acidosis:**	**Non AG metabolic acidosis:**	**Cardio-pulmonary:**	**Saline responders:**
Brainstem injury: stroke tumor	**M** - methanol	**U** - ureteroenteric fistula	Hypoxia	GI loss: vomiting, NG suction
Central sleep apnea	**U** - uremia	**S** - IV Normal Saline	Pneumonia	Renal loss: diuretics
Obesity hypoventilation syndrome	**D** - DKA, alcoholic KA, starvation KA	**E** - early renal failure	Early restrictive lung disease	Skin loss: burns, sweat
Respirators:	**P** - paraldehyde, phenformin, metformin	**D** - diarrhea	Mild CHF	↓ Fluid intake
Upper airway obstruction: laryngospasm epiglottitis	**I** - iron, isoniazide	**C** - carbonic anhydrase inhibitors such as acetazolamide	PE	**Saline nonresponders:**
Lower airway obstruction: COPD, asthma, sleep apnea	**L** - lactic acidosis	**A** - amphotericin	Mechanical ventilation	Mineralocortisolism: Conn's syndrome
Dead space ventilation: infection, pleural effusion	**E** - ethylene glycol	**R** - RTA I, II, IV	**Non-cardio-pulmonary:**	Mineralocortisolism: Cushing's syndrome
Muscular:	**S** - salicylates		Fever	Renin production: tumor
Myasthenia gravis	**C** - cyanide		Sepsis	Severe hypokalemia
Guillain-Barre	**A** - arsenic		Anxiety	Gitelmann syndrome
Myopathy	**T** - toluene		Pregnancy	Barter syndrome
ALS			Hyperthyroidism	HCO_3 load: sodium bicarb infusion, citrate with transfusions, acetate with TPN
Hypokalemia			Liver failure	
Drugs:			Drugs: salicylates initially, progesterone	
Opioids				
Tx: intubation, mechanical ventilation, treat underlying disease, nalozone, etc.	Tx: correct underlying disorder, $NaHCO_3$ if pH<7.2, HCO_3 deficit (mmol) = (desired bicarbonate – measured bicarbonate) x weight (kg) x 0.6 replace $^1/_2$ total deficit over 8-12h		Tx: treat underlying disorder, hyperventilation – rebreathe into paperbag	Tx: saline responders – volume repletion saline nonresponders – treat underlying condition

Figure 12.2. Differential diagnosis for acid–base disorders.

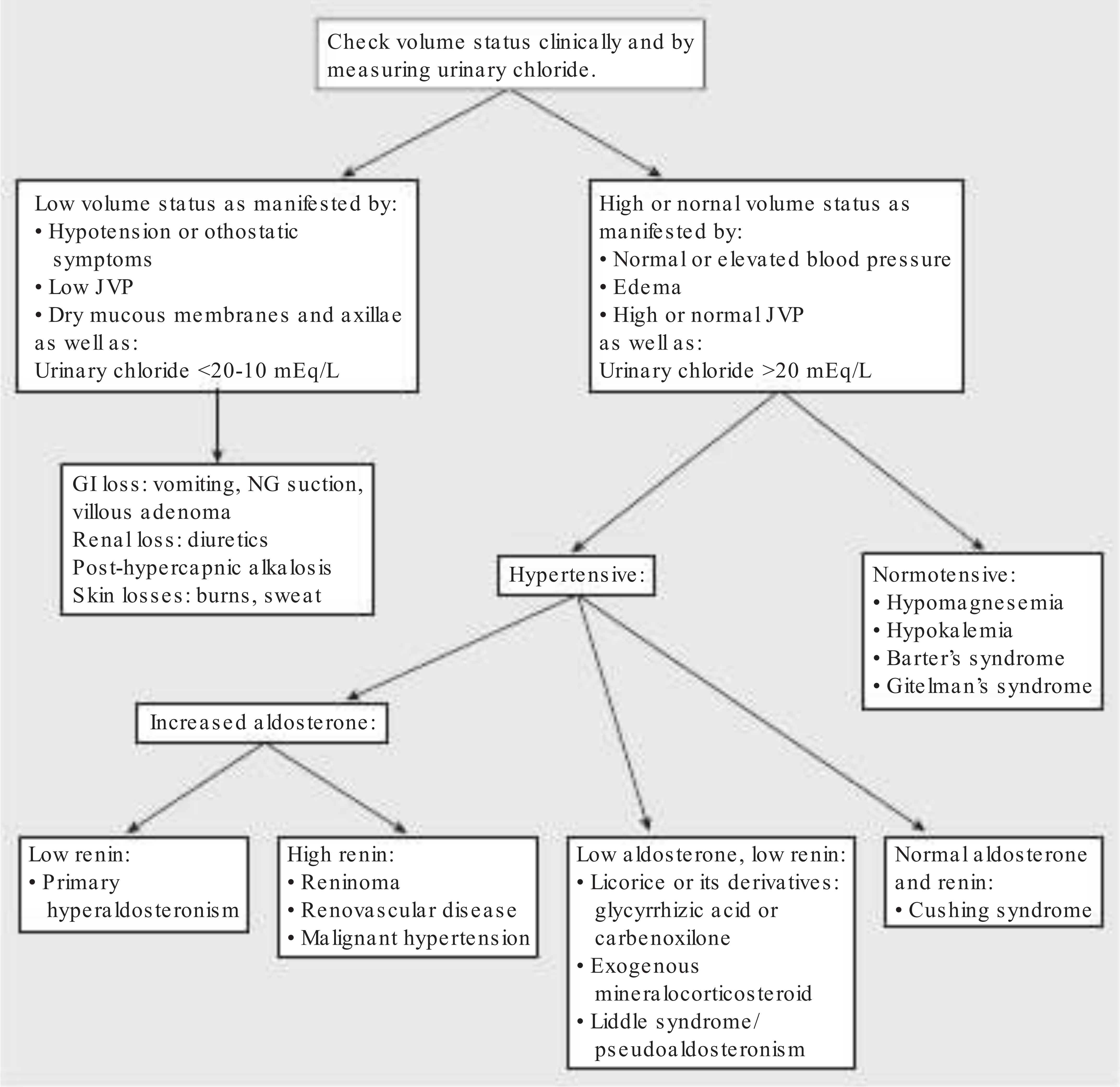

Check volume status clinically and by measuring urinary chloride.
Low volume status as manifested by:
• Hypotension or othostatic symptoms
• Low JVP
• Dry mucous membranes and axillae
as well as:
Urinary chloride <20-10 mEq/L
High or nornal volume status as manifested by:
• Normal or elevated blood pressure
• Edema
• High or normal JVP
as well as:
Urinary chloride >20 mEq/L
GI loss: vomiting, NG suction, villous adenoma
Renal loss: diuretics
Post-hypercapnic alkalosis
Skin losses: burns, sweat
Hypertensive:
Normotensive:
• Hypomagnesemia
• Hypokalemia
• Barter's syndrome
• Gitelman's syndrome
Increased aldosterone:
Low renin:
• Primary hyperaldosteronism
High renin:
• Reninoma
• Renovascular disease
• Malignant hypertension
Low aldosterone, low renin:
• Licorice or its derivatives: glycyrrhizic acid or carbenoxilone
• Exogenous mineralocorticosteroid
• Liddle syndrome/ pseudoaldosteronism
Normal aldosterone and renin:
• Cushing syndrome

Figure 12.3. Approach to metabolic alkalosis.

HYPOMAGNESEMIA

MCC OBJECTIVE

Currently listed as a component of Objective #12-2 (Calcium Disorders) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Rationale

- ≈10% of hospitalized and > 60% of critically ill patients
- Commonly associated with hypokalemia and hypocalcemia (chronic hypomagnesemia → ↓ PTH secretion and ↓ bone response to PTH)

Renal Handling of Mg

- 1% of total body Mg^{2+} is in the extracellular fluid.
- Mg^{2+} deficiency may be significantly underestimated by serum Mg^{2+} levels.
- ≈70% of plasma Mg^{2+} is filterable; the rest is bound to albumin (therefore, must multiply plasma Mg^{2+} by 0.7 when calculating FEMg).
- ≈95% of filtered Mg^{2+} is reabsorbed under physiologic conditions (60%–70% at the TAL, 15%–25% at the PCT, 5%–10% at the DCT).
- ECF expansion → ↑ renal Mg^{2+} excretion and ↓ Mg^{2+} resorption in the loop of Henle
- ↓ GFR → ↓ filtered Mg^{2+} load → ↓ fractional Mg^{2+} reabsorption
- Hypercalcemia and hypermagnesemia → ↓ Mg^{2+} reabsorption

CLINICAL box

Hypomagnesemia

- Serum $[Mg^{2+}]$ < 1.5 mEq/L or 0.75 mmol/L
- Normal = 1.5 to 2.0 mEq/L or 0.75 to 1 mmol/L or 1.7 to 2.4 mg/dL

- Phosphate depletion → ↑ urinary Mg^{2+} excretion
- Chronic metabolic acidosis → ↑ Mg^{2+} excretion
- Chronic metabolic alkalosis → ↓ Mg^{2+} excretion
- Hypomagnesemia can exacerbate digitalis toxicity.
- Normomagnesemic Mg^{2+} depletion should be considered in refractory hypokalemia and hypocalcemia.

CLINICAL box

Common Associations Seen with Hypomagnesemia

- Malnutrition
- Alcoholism
- Electrolyte imbalances
- Diuretics
- Large volumes of IV fluids
- Nephrotoxic agents
- Cisplatin
- Parenteral nutrition
- Proton pump inhibitors
- Diabetes mellitus

CAUSAL CONDITIONS

- ↓ Intake
- ↓ Absorption
- ↑ Losses
  - GI
  - Renal losses
  - Skin
- Redistribution
  - Hungry bones
  - Redistribution to bones, refeeding syndrome
  - Diabetes mellitus

APPROACH (Figure 12.4)

For clinical systems affected by hypomagnesemia, see Table 12.4.

CLINICAL box

Check for hypomagnesemia in patients with ventricular arrhythmias (particularly if ischemia + diuretic use)

ECG Δs 2° to hypomagnesemia are the same as those 2° to hypokalemia.

CLINICAL box

Fractional excretion of Mg:

$$FEMg = \frac{UMg \times P_{Cr}}{0.7 \times PMg \times U_{Cr}} \times 100\%$$

HYPERKALEMIA

MCC OBJECTIVE

Based on Objective #79-1 (Hyperkalemia) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Definition

- Serum K^+ > 5.0 mEq/L

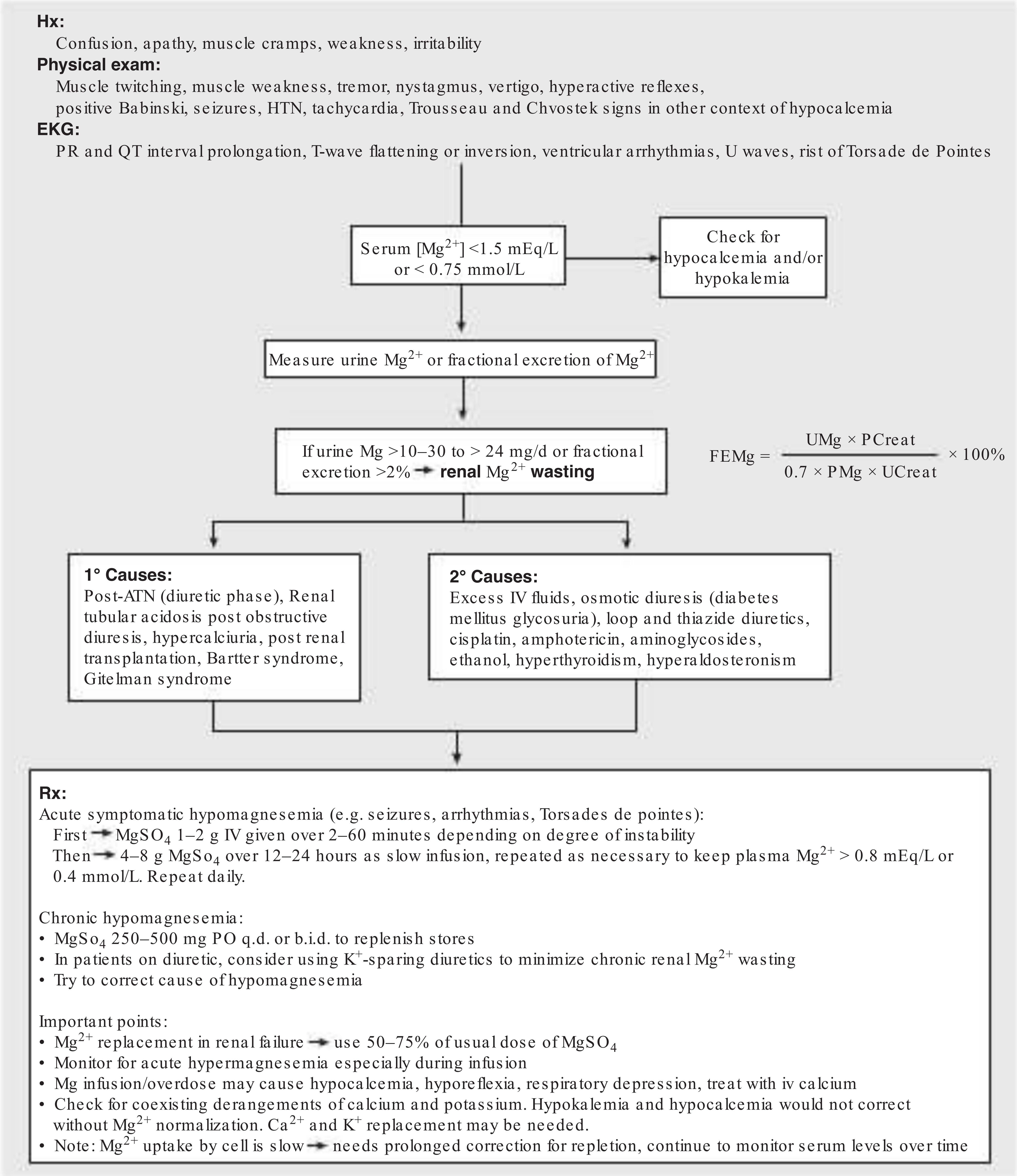
APPLIED SCIENTIFIC CONCEPTS

K Adaptation

- Renal response to prolonged (> 20 d) ↑ in K^+ load (e.g., from ↑ dietary intake)
- Significant ↑ in the efficiency of renal K^+ excretion
- Mediated by enhanced activity of Na^+/K^+-ATPases of renal principal cells
- Manifested by gradual return of K^+ and aldosterone level to near normal
- Reabsorption of K^+ in the PCT and the loop of Henle remains, however, at a constant rate

CLINICAL box

- Total body stores:
  - 2% is extracellular.
  - 98% is redistributed between muscle (3,000 mEq), liver (200 mEq), and RBCs (235 mEq).
- Intake:
  - Mainly oral (around 100 mEq/d)
- Excretion:
  - Mainly kidneys (on average 92 mEq/d, but healthy kidneys have enormous potential and can excrete up to 400 mEq/d; this is why severe constipation may cause unexplained hyperkalemia in patients with CKD/ESRD)
  - Sweat (minimal)



Hx:
Confusion, apathy, muscle cramps, weakness, irritability

Physical exam:
Muscle twitching, muscle weakness, tremor, nystagmus, vertigo, hyperactive reflexes, positive Babinski, seizures, HTN, tachycardia, Trousseau and Chvostek signs in other context of hypocalcemia

EKG:
PR and QT interval prolongation, T-wave flattening or inversion, ventricular arrhythmias, U waves, rist of Torsade de Pointes

Serum [Mg^{2+}] <1.5 mEq/L or < 0.75 mmol/L

Check for hypocalcemia and/or hypokalemia

Measure urine Mg^{2+} or fractional excretion of Mg^{2+}

If urine Mg >10–30 to > 24 mg/d or fractional excretion >2% → **renal** Mg^{2+} **wasting**

$$FEMg = \frac{UMg \times PCreat}{0.7 \times PMg \times UCreat} \times 100\%$$

1° Causes:
Post-ATN (diuretic phase), Renal tubular acidosis post obstructive diuresis, hypercalciuria, post renal transplantation, Bartter syndrome, Gitelman syndrome

2° Causes:
Excess IV fluids, osmotic diuresis (diabetes mellitus glycosuria), loop and thiazide diuretics, cisplatin, amphotericin, aminoglycosides, ethanol, hyperthyroidism, hyperaldosteronism

Rx:
Acute symptomatic hypomagnesemia (e.g. seizures, arrhythmias, Torsades de pointes):
First → $MgSO_4$ 1–2 g IV given over 2–60 minutes depending on degree of instability
Then → 4–8 g $MgSo_4$ over 12–24 hours as slow infusion, repeated as necessary to keep plasma Mg^{2+} > 0.8 mEq/L or 0.4 mmol/L. Repeat daily.

Chronic hypomagnesemia:
- $MgSo_4$ 250–500 mg PO q.d. or b.i.d. to replenish stores
- In patients on diuretic, consider using K^+-sparing diuretics to minimize chronic renal Mg^{2+} wasting
- Try to correct cause of hypomagnesemia

Important points:
- Mg^{2+} replacement in renal failure → use 50–75% of usual dose of $MgSO_4$
- Monitor for acute hypermagnesemia especially during infusion
- Mg infusion/overdose may cause hypocalcemia, hyporeflexia, respiratory depression, treat with iv calcium
- Check for coexisting derangements of calcium and potassium. Hypokalemia and hypocalcemia would not correct without Mg^{2+} normalization. Ca^{2+} and K^+ replacement may be needed.
- Note: Mg^{2+} uptake by cell is slow → needs prolonged correction for repletion, continue to monitor serum levels over time

Figure 12.4. Approach to hypomagnesemia.

TABLE 12.4 • Clinical systems affected by hypomagnesemia

Cardiac	Arrhythmias, ECG abnormalities, vascular tone
Neurologic	Tremor, twitching, tetany, Chvostek, Trousseau, vertical nystagmus
Bones	Reduced bone mass, reduced PTH synthesis
Electrolyte balance	Hypokalemia, hypocalcemia
Metabolic changes	Insulin resistance

CAUSAL CONDITIONS (Figure 12.5)

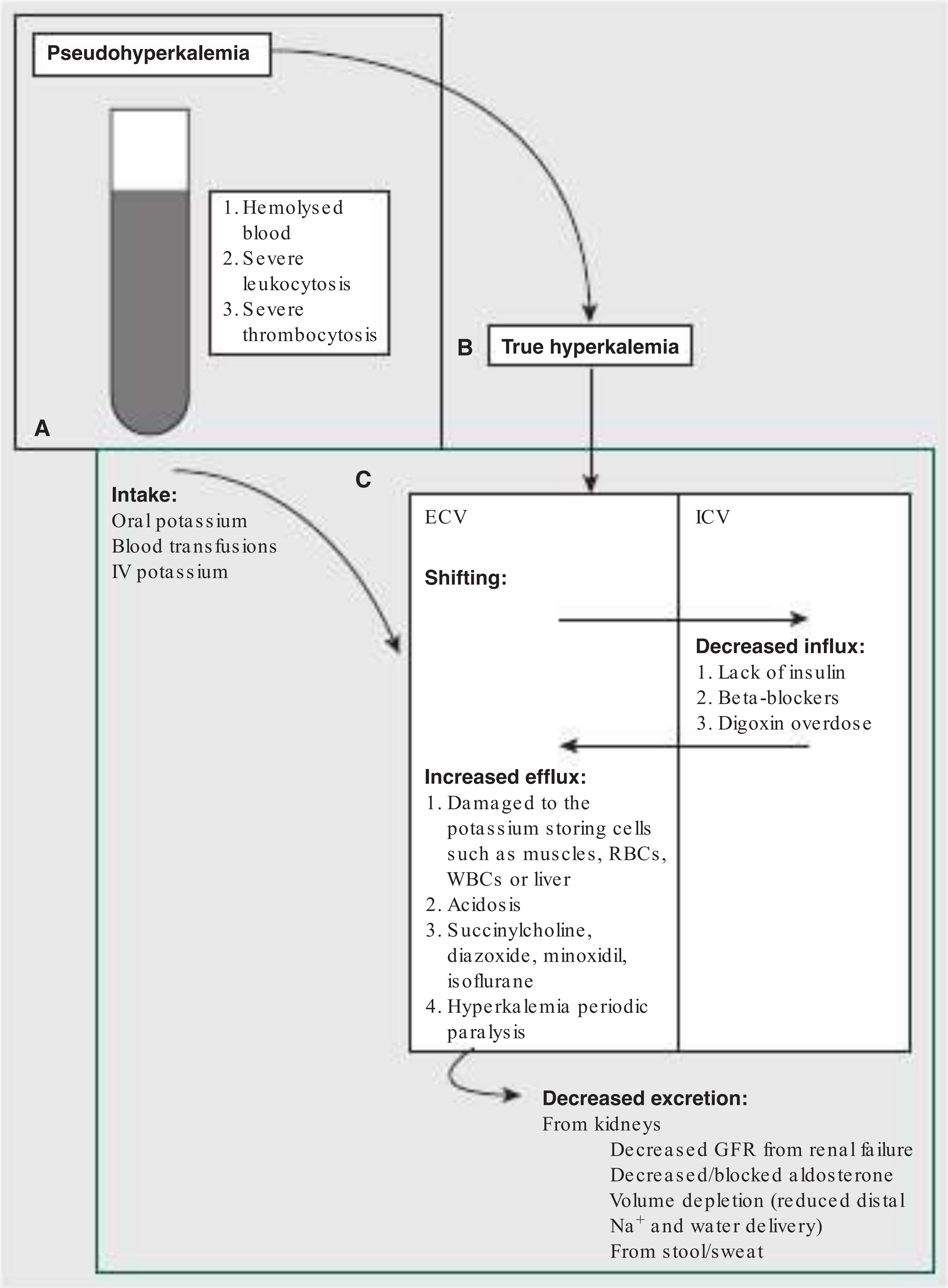


Figure 12.5. Causes of hyperkalemia.

Renal Potassium Excretion (Figure 12.6)

APPROACH (Figure 12.7)

Effects of Hyperkalemia on ECG

- Peaked T waves (definition: "tented" narrow based, > 10 mm in precordial, > 5 mm in limb leads or relatively tall compared with baseline)
- Shortened QT internal (QTc < 0.36 sec)
- Prolongation of PR interval, then QRS
- P wave flattening, then disappearance
- Sine wave pattern (usually $K^+ > 8$ mEq/L)
- Ventricular standstill (flat line)
- Arrhythmias: bradycardias, Vtach, Vfib

CLINICAL box

Rule out pseudohyperkalemia by:
- Verifying sample for hemolysis
- Repeating plasma K^+

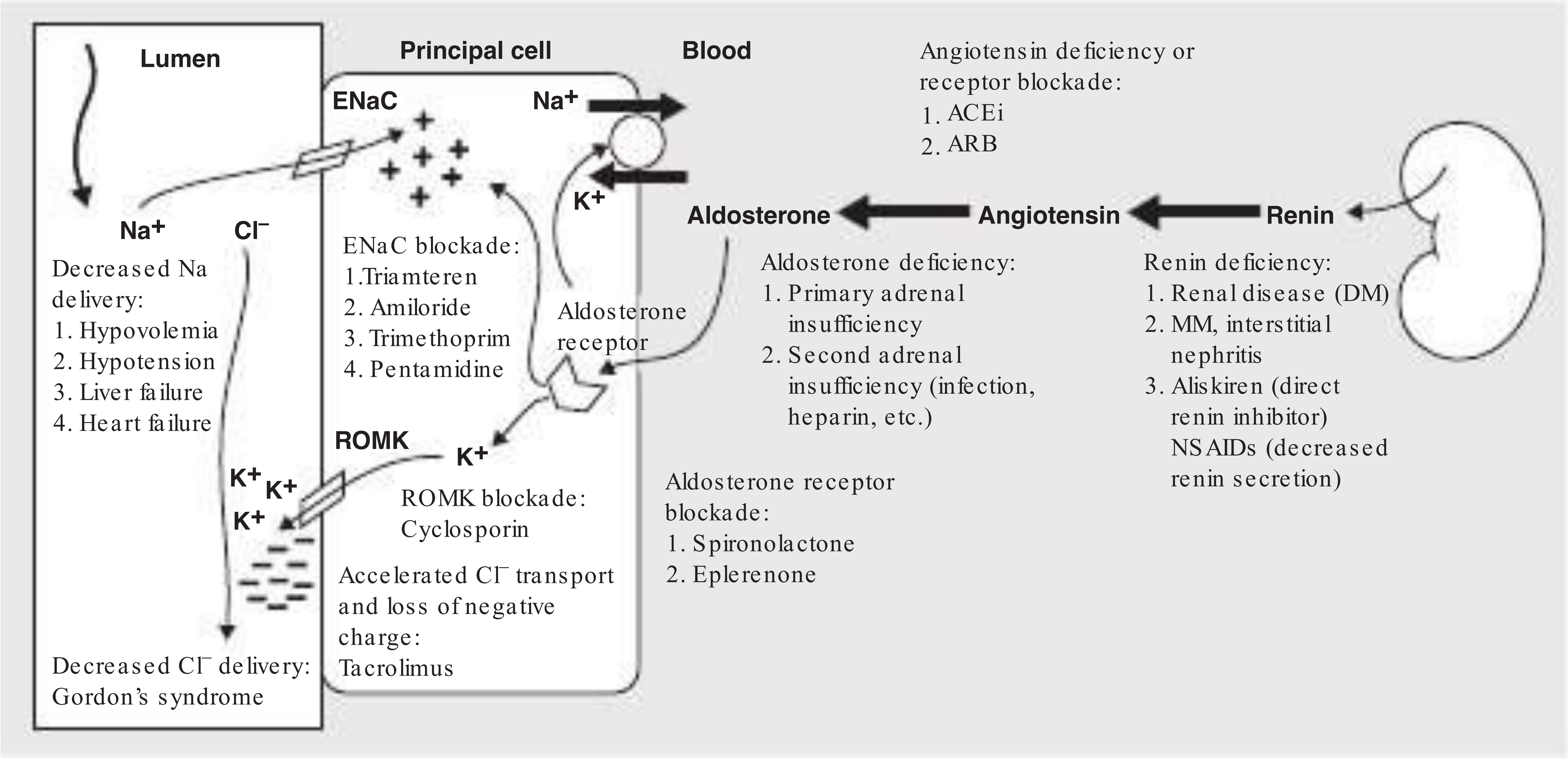
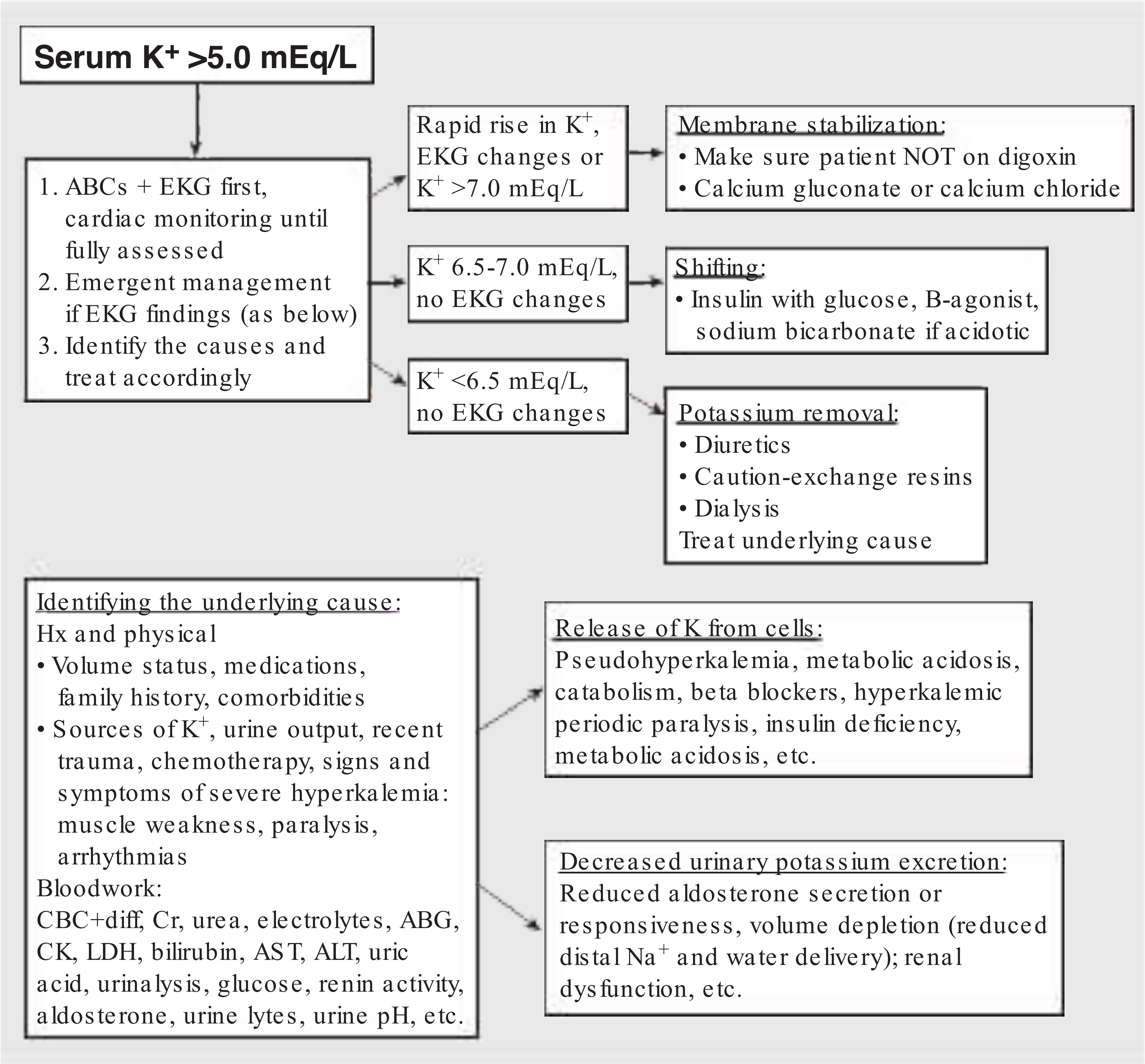


Figure 12.6. Role of kidney's in potassium excretion.



Serum K^+ >5.0 mEq/L

1. ABCs + EKG first, cardiac monitoring until fully assessed
2. Emergent management if EKG findings (as below)
3. Identify the causes and treat accordingly

Rapid rise in K^+, EKG changes or K^+ >7.0 mEq/L

Membrane stabilization:
- Make sure patient NOT on digoxin
- Calcium gluconate or calcium chloride

K^+ 6.5-7.0 mEq/L, no EKG changes

Shifting:
- Insulin with glucose, B-agonist, sodium bicarbonate if acidotic

K^+ <6.5 mEq/L, no EKG changes

Potassium removal:
- Diuretics
- Caution-exchange resins
- Dialysis

Treat underlying cause

Identifying the underlying cause:
Hx and physical
- Volume status, medications, family history, comorbidities
- Sources of K^+, urine output, recent trauma, chemotherapy, signs and symptoms of severe hyperkalemia: muscle weakness, paralysis, arrhythmias

Bloodwork:
CBC+diff, Cr, urea, electrolytes, ABG, CK, LDH, bilirubin, AST, ALT, uric acid, urinalysis, glucose, renin activity, aldosterone, urine lytes, urine pH, etc.

Release of K from cells:
Pseudohyperkalemia, metabolic acidosis, catabolism, beta blockers, hyperkalemic periodic paralysis, insulin deficiency, metabolic acidosis, etc.

Decreased urinary potassium excretion:
Reduced aldosterone secretion or responsiveness, volume depletion (reduced distal Na^+ and water delivery); renal dysfunction, etc.

Figure 12.7. Approach to hyperkalemia.

HYPOKALEMIA

MCC OBJECTIVE

Based on Objective #79-2 (Hypokalemia) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Definition

- Serum $K^+ < 3.5$ mEq/L

Rationale

- Common incidental finding on routine serum electrolytes and ECG
- Severe deficits likely chronic and symptoms tend to develop late

CLINICAL box

Hypokalemia is frequently multifactorial, for example, anorexia nervosa (starvation, diuretics laxatives).

CAUSAL CONDITIONS (Figure 12.8)

Renal Potassium Wasting (Figure 12.9)

APPROACH (Figure 12.10)

ABC First

- Look for acute life-threatening manifestations (Table 12.5)

CLINICAL box

Diuretics

Loop and thiazide diuretics cause chloride depletion and hypovolemia with metabolic alkalosis. K^+ depletion is caused by three mechanisms:

1. Increased flow and delivery of NaCl to CCD
2. Alkalemia (redistribution)
3. Hypovolemia with activation of renin-angiotensin-aldosterone system

- Usually with $K^+ < 3$ mEq/L, affects mainly muscles

Therapy

1. Check Mg^{2+}
2. Replace immediately if severe hypokalemia
3. Estimate deficit: each ↓ by 0.27 mEq/L = 100 mEq deficit (rough estimate)
4. Identify the cause and apply specific therapy

CLINICAL box

Severe/Life-Threatening Hypokalemia ($K^+ \leq 2.5$–3 mEq/L)

Replace immediately but be aware that redistributive hypokalemia (shifts) is transient and may result in rebound hyperkalemia (maximum K^+ IV rate is 20 mEq/h, oral 60 mEq × 1, then repeat serum level)

Give PO unless paralysis, arrhythmias present, or DKA

40 to 60 mEq acutely increase K^+ by 1 to 1.5 mEq/L

Measure K^+ q2–4h until safe levels achieved; slow down rate of replacement especially if redistributive hypokalemia

Mild to Moderate Hypokalemia ($K^+ > 3.0$ mEq/L)

Look for cause

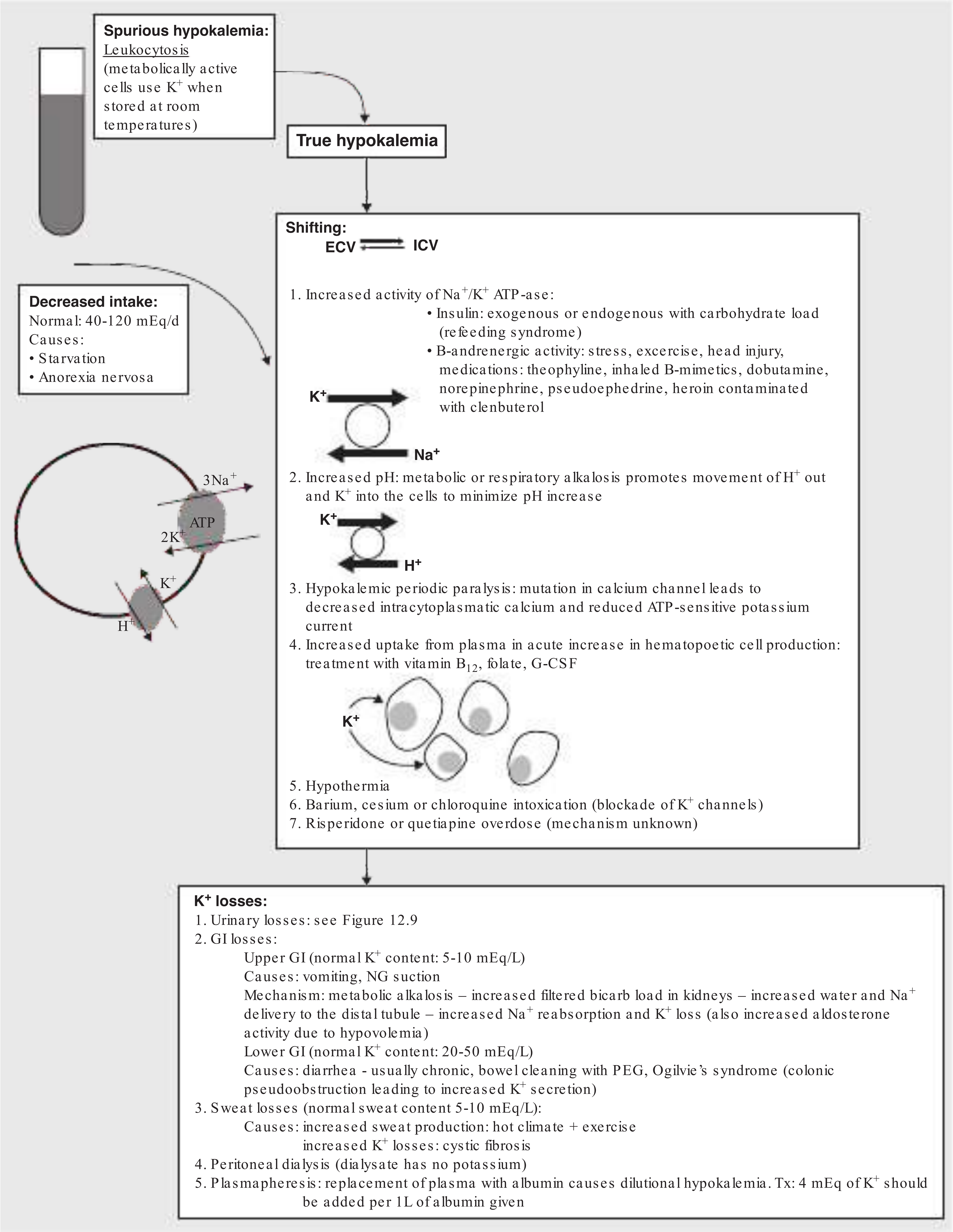
Replace slowly

Specific Therapies

1° hyperaldosteronism: remove adenoma, spironolactone

Barter/Gitelman syndromes: amiloride, K^+ supplements

GI losses: KCl 20 mEq PO q.i.d. if alkalosis; potassium bicarbonate if acidosis



Spurious hypokalemia:
Leukocytosis
(metabolically active cells use K^+ when stored at room temperatures)

True hypokalemia

Decreased intake:
Normal: 40-120 mEq/d
Causes:
- Starvation
- Anorexia nervosa

Shifting:
ECV ⇄ ICV

1. Increased activity of Na^+/K^+ ATP-ase:
    - Insulin: exogenous or endogenous with carbohydrate load (refeeding syndrome)
    - B-andrenergic activity: stress, excercise, head injury, medications: theophyline, inhaled B-mimetics, dobutamine, norepinephrine, pseudoephedrine, heroin contaminated with clenbuterol
2. Increased pH: metabolic or respiratory alkalosis promotes movement of H^+ out and K^+ into the cells to minimize pH increase
3. Hypokalemic periodic paralysis: mutation in calcium channel leads to decreased intracytoplasmatic calcium and reduced ATP-sensitive potassium current
4. Increased uptake from plasma in acute increase in hematopoetic cell production: treatment with vitamin B_{12}, folate, G-CSF
5. Hypothermia
6. Barium, cesium or chloroquine intoxication (blockade of K^+ channels)
7. Risperidone or quetiapine overdose (mechanism unknown)

K^+ losses:
1. Urinary losses: see Figure 12.9
2. GI losses:
    Upper GI (normal K^+ content: 5-10 mEq/L)
    Causes: vomiting, NG suction
    Mechanism: metabolic alkalosis – increased filtered bicarb load in kidneys – increased water and Na^+ delivery to the distal tubule – increased Na^+ reabsorption and K^+ loss (also increased aldosterone activity due to hypovolemia)
    Lower GI (normal K^+ content: 20-50 mEq/L)
    Causes: diarrhea - usually chronic, bowel cleaning with PEG, Ogilvie's syndrome (colonic pseudoobstruction leading to increased K^+ secretion)
3. Sweat losses (normal sweat content 5-10 mEq/L):
    Causes: increased sweat production: hot climate + exercise
    increased K^+ losses: cystic fibrosis
4. Peritoneal dialysis (dialysate has no potassium)
5. Plasmapheresis: replacement of plasma with albumin causes dilutional hypokalemia. Tx: 4 mEq of K^+ should be added per 1L of albumin given

Figure 12.8. Causes of hypokalemia.

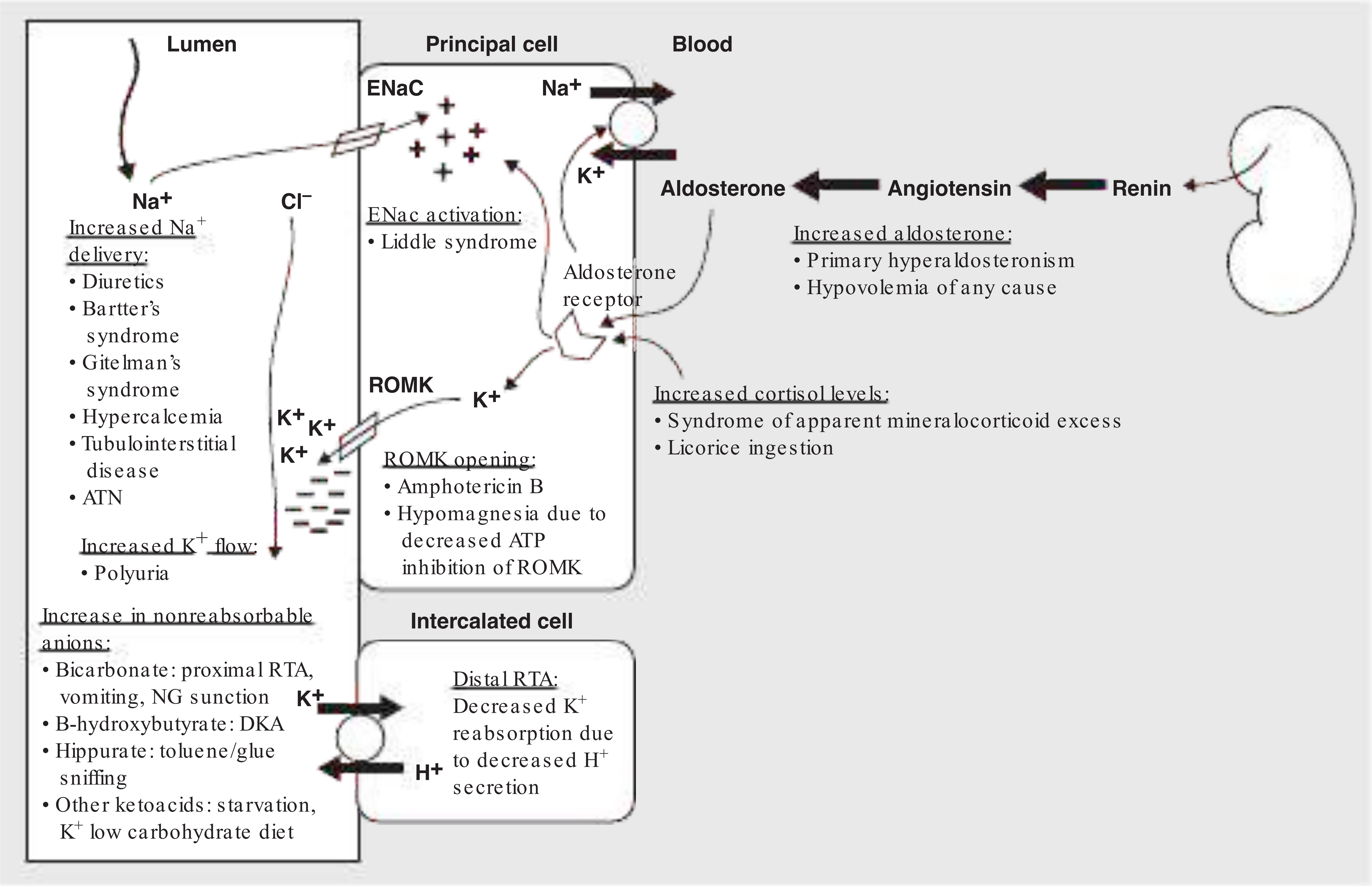

Lumen
Principal cell
Blood
ENaC
Na+
K+
Aldosterone
Angiotensin
Renin
Na+
Cl−
Increased Na+ delivery:
• Diuretics
• Bartter's syndrome
• Gitelman's syndrome
• Hypercalcemia
• Tubulointerstitial disease
• ATN
ENac activation:
• Liddle syndrome
Aldosterone receptor
Increased aldosterone:
• Primary hyperaldosteronism
• Hypovolemia of any cause
ROMK
K+
K+
K+
K+
Increased cortisol levels:
• Syndrome of apparent mineralocorticoid excess
• Licorice ingestion
ROMK opening:
• Amphotericin B
• Hypomagnesia due to decreased ATP inhibition of ROMK
Increased K+ flow:
• Polyuria
Increase in nonreabsorbable anions:
• Bicarbonate: proximal RTA, vomiting, NG sunction
• B-hydroxybutyrate: DKA
• Hippurate: toluene/glue sniffing
• Other ketoacids: starvation, K+ low carbohydrate diet
Intercalated cell
K+
H+
Distal RTA: Decreased K+ reabsorption due to decreased H+ secretion

Figure 12.9. Renal potassium wasting.

PROTEINURIA

MCC OBJECTIVE

Based on Objective #84 (Proteinuria) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Rationale

- Proteinuria usually incidental discovery (positive dipstick); if persistent → likely impaired glomerular permselectivity.
- Proteinuria may be isolated or associated with hematuria and/or elevation of creatinine.
- Screening for proteinuria is recommended for patient at risk of renal disease (e.g., diabetes mellitus, hypertension).
- Only albuminuria is detected by urine dipstick. However, dipsticks are not sensitive enough to reliably detect microalbuminuria. Therefore, if dipstick is negative but at risk of renal disease, check urine microalbumin to creatinine ratio (ACR).
- Urine protein to creatinine ratio (PCR) detects all protein in urine, not sensitive at low values.
- If dipstick is negative and PCR is elevated, consider presence of nonalbumin proteins in urine (e.g., paraproteins). A 24-h urine is required for analysis and diagnosis.
- Higher grades of proteinuria have higher risk of renal disease progression.
- Proteinuria is a risk marker for cardiovascular disease.

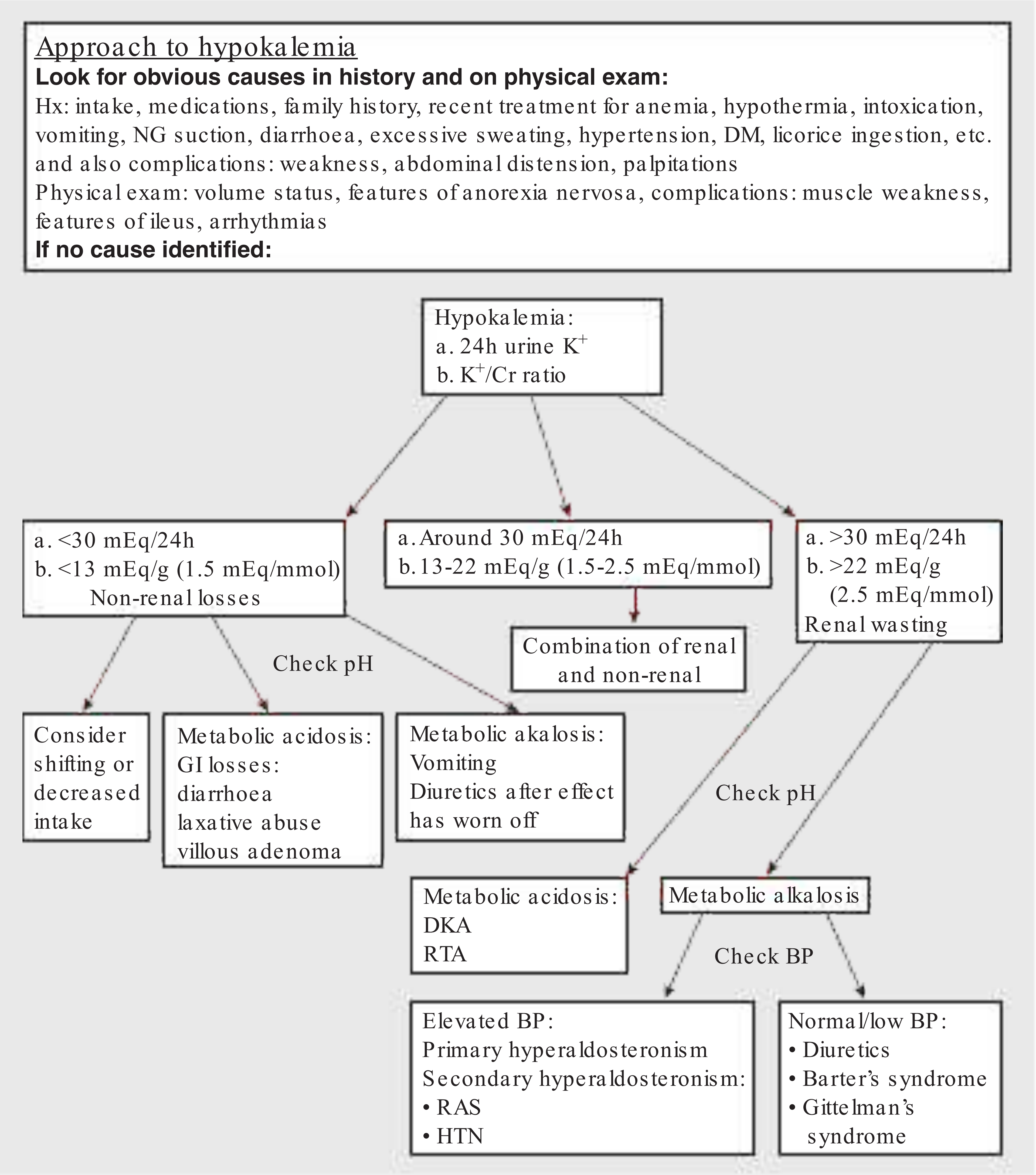

Approach to hypokalemia
Look for obvious causes in history and on physical exam:
Hx: intake, medications, family history, recent treatment for anemia, hypothermia, intoxication, vomiting, NG suction, diarrhoea, excessive sweating, hypertension, DM, licorice ingestion, etc. and also complications: weakness, abdominal distension, palpitations
Physical exam: volume status, features of anorexia nervosa, complications: muscle weakness, features of ileus, arrhythmias
If no cause identified:
Hypokalemia: a. 24h urine K+ b. K+/Cr ratio
a. <30 mEq/24h b. <13 mEq/g (1.5 mEq/mmol) Non-renal losses
a. Around 30 mEq/24h b. 13-22 mEq/g (1.5-2.5 mEq/mmol)
a. >30 mEq/24h b. >22 mEq/g (2.5 mEq/mmol) Renal wasting
Combination of renal and non-renal
Check pH
Consider shifting or decreased intake
Metabolic acidosis: GI losses: diarrhoea laxative abuse villous adenoma
Metabolic akalosis: Vomiting Diuretics after effect has worn off
Check pH
Metabolic acidosis: DKA RTA
Metabolic alkalosis
Check BP
Elevated BP: Primary hyperaldosteronism Secondary hyperaldosteronism: • RAS • HTN
Normal/low BP: • Diuretics • Barter's syndrome • Gittelman's syndrome

Figure 12.10. Approach to hypokalemia.

TABLE 12.5 • Life-threatening manifestations of hypokalemia

	Symptom
Muscle Affected	
Skeletal muscles (K^+ < 2.5)	Weakness that starts in lower extremities and progresses to upper extremities, respiratory muscle paralysis, rhabdomyolysis
Intestinal muscles	Ileus
Cardiac muscle	Arrhythmias
	ECG changes:
	QT ↑, ST ↓, U wave in V4–V6, ↓ T-wave amplitude
Other Organs	
Kidneys	Decreased concentration ability and polyuria
Metabolic changes	Glucose intolerance

CLINICAL box

Definitions

Proteinuria → urinary total protein excretion > 150 mg/d with ≥ 30 mg/d albumin
Microalbuminuria → 30 to 300 mg/d albumin
Nephrotic proteinuria → > 3.5 g/d total protein

CLINICAL box

Severity

- > 2 g/d → likely glomerular disease
- 0.15 to 2 g/d → likely tubular proteinuria, overflow proteinuria, or mild glomerular disease

CAUSAL CONDITIONS (Table 12.6)

TABLE 12.6 • Type of proteinuria

Benign generally < 1–2 g/d; normal renal function; persists for years without deterioration in renal function				
Transient intermittent proteinuria (< 5%) with fever, dehydration, intense exercise, emotional upset, heat injury, inflammation				
Orthostatic (5% of adolescents): > 50 mg/8 h while upright				
Persistent				
Origin	Dipstick Protein	Urine Sediment	Type of Proteinuria	Clinical Associations
Glomerular—↑ glomerular permeability to protein	Positive	Active (dysmorphic red cells, white cells, casts)	Albumin and immunoglobulins	Nephritic syndrome, 1° or 2° glomerulonephritis, systemic disorders, e.g., lupus, vasculitis, drugs, Henoch-schonlein purpura, cryoglobulinemia, hepatitis B and C, endocarditis
		Nonactive (may have few cells, noncellular casts)	Albumin and immunoglobulins	1° or 2° nephrotic syndrome, diabetic nephropathy, 2° FSGS, amyloid, hypertensive nephrosclerosis, PCKD
Tubular—↓ reabsorption of filtered proteins	Negative	May be negative or white cells, casts	Low molecular weight proteins	Tubule-interstitial disease, drugs, chronic pyelonephritis, Fanconi, sickle cell disease, radiation nephritis, heavy metals, Sjögren, obstructive uropathy
Overflow—filtered load > tubular reabsorptive capacity	Negative	May be negative	Light chains, lysozyme, myoglobin, hemoglobin	Multiple myeloma, MGUS, amyloid, hemoglobinuria, myoglobinuria

APPROACH (Figure 12.11)

- For an explanation of the degree of proteinuria, see Figure 12.12.
- For clinical features of nephritic and nephritic syndromes, see Table 12.7.

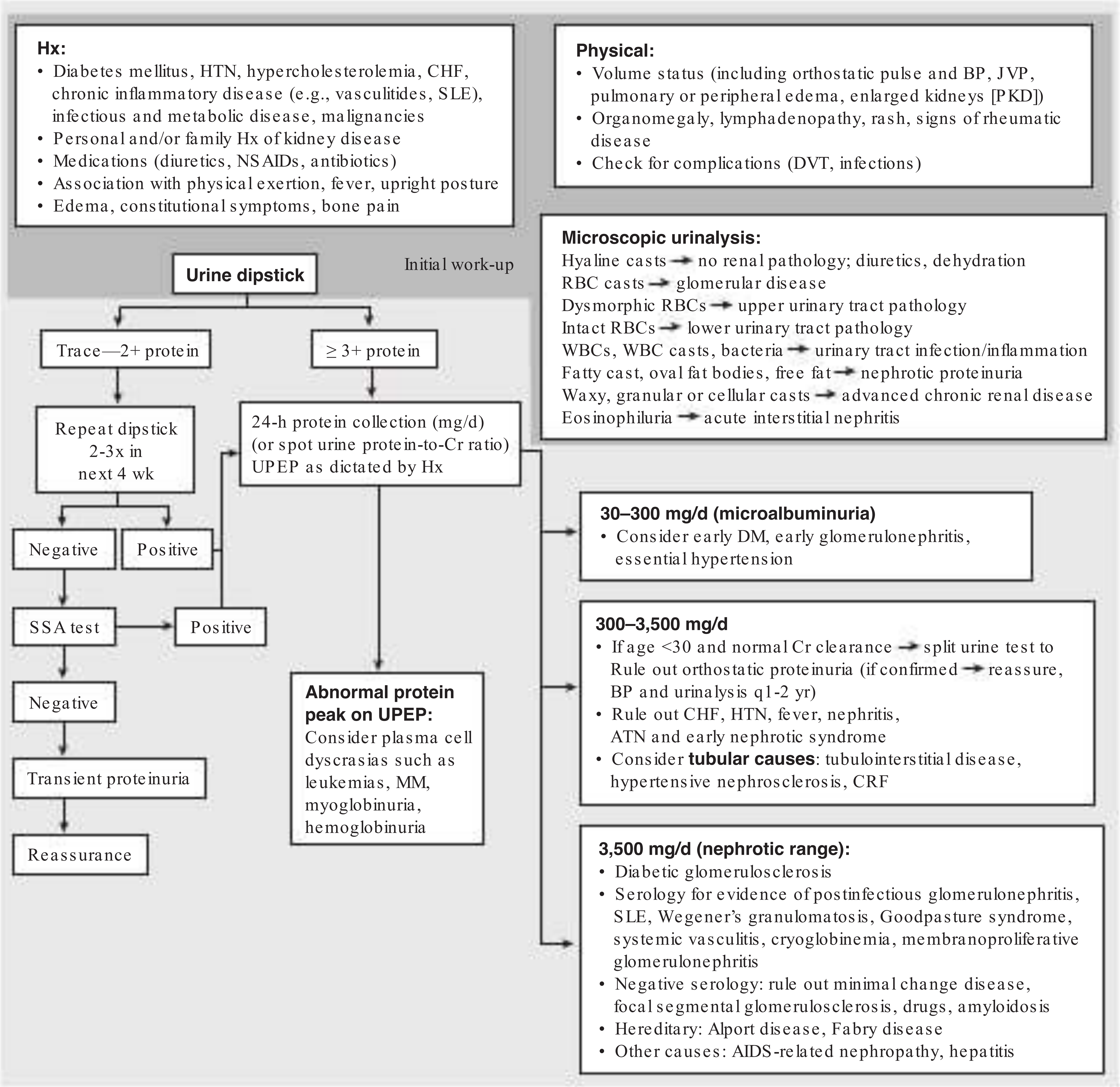
Management

- If 1° nephrotic syndrome or 1° glomerulonephritis, treat according to published protocols in addition to conservative measures outlined below
- If 2° syndrome, treat underlying disorder in addition to conservative measures outlined below
- If 1° glomerular disease → treat with corticosteroids, diuretics, cytotoxic agents, antihypertensives, and plasmapheresis as appropriate
- If HTN → BP control
  - Target BP < 125/75 mm Hg
  - ACEIs and ARBs preferred (have a proteinuria-reducing effect independent of anti-HTN effect)

CLINICAL box

Normally Excreted Proteins

- 40% Tamm-Horsfall mucoproteins
- 40% albumin
- 20% Igs



Hx:

- Diabetes mellitus, HTN, hypercholesterolemia, CHF, chronic inflammatory disease (e.g., vasculitides, SLE), infectious and metabolic disease, malignancies
- Personal and/or family Hx of kidney disease
- Medications (diuretics, NSAIDs, antibiotics)
- Association with physical exertion, fever, upright posture
- Edema, constitutional symptoms, bone pain

Physical:

- Volume status (including orthostatic pulse and BP, JVP, pulmonary or peripheral edema, enlarged kidneys [PKD])
- Organomegaly, lymphadenopathy, rash, signs of rheumatic disease
- Check for complications (DVT, infections)

Microscopic urinalysis:

Hyaline casts → no renal pathology; diuretics, dehydration
RBC casts → glomerular disease
Dysmorphic RBCs → upper urinary tract pathology
Intact RBCs → lower urinary tract pathology
WBCs, WBC casts, bacteria → urinary tract infection/inflammation
Fatty cast, oval fat bodies, free fat → nephrotic proteinuria
Waxy, granular or cellular casts → advanced chronic renal disease
Eosinophiluria → acute interstitial nephritis

24-h protein collection (mg/d) (or spot urine protein-to-Cr ratio) UPEP as dictated by Hx

Abnormal protein peak on UPEP: Consider plasma cell dyscrasias such as leukemias, MM, myoglobinuria, hemoglobinuria

30–300 mg/d (microalbuminuria)

- Consider early DM, early glomerulonephritis, essential hypertension

300–3,500 mg/d

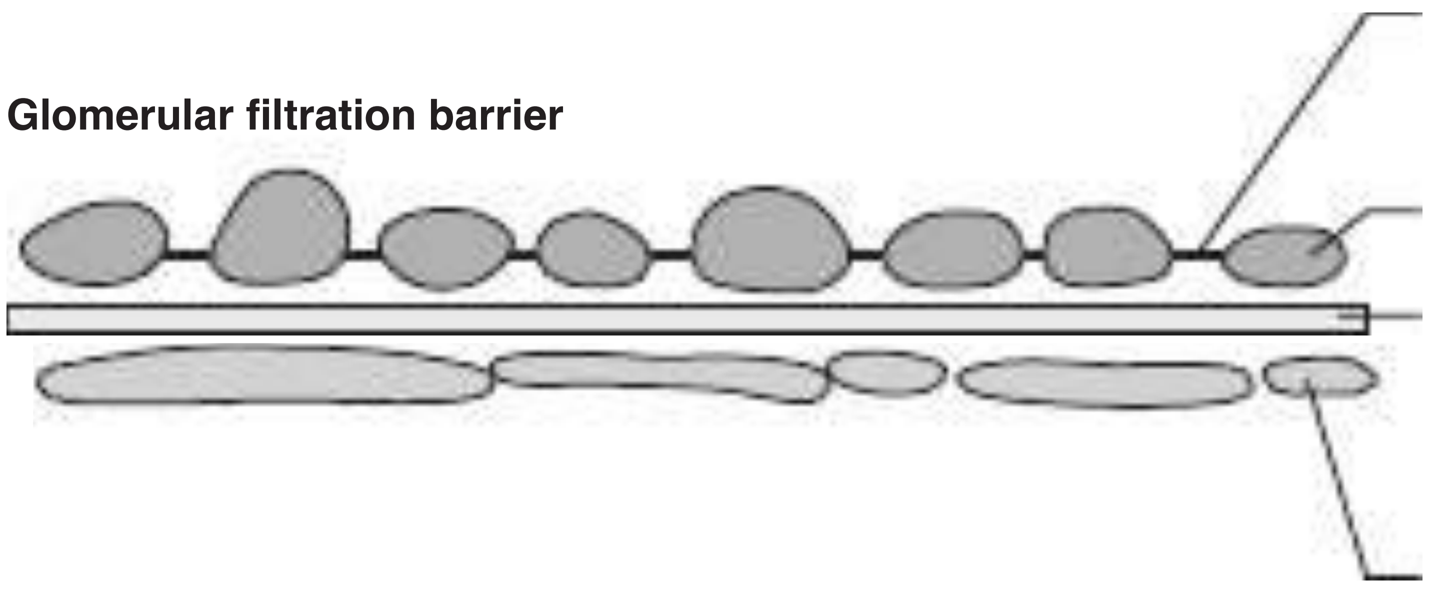
- If age <30 and normal Cr clearance → split urine test to Rule out orthostatic proteinuria (if confirmed → reassure, BP and urinalysis q1-2 yr)
- Rule out CHF, HTN, fever, nephritis, ATN and early nephrotic syndrome
- Consider **tubular causes**: tubulointerstitial disease, hypertensive nephrosclerosis, CRF

3,500 mg/d (nephrotic range):

- Diabetic glomerulosclerosis
- Serology for evidence of postinfectious glomerulonephritis, SLE, Wegener's granulomatosis, Goodpasture syndrome, systemic vasculitis, cryoglobinemia, membranoproliferative glomerulonephritis
- Negative serology: rule out minimal change disease, focal segmental glomerulosclerosis, drugs, amyloidosis
- Hereditary: Alport disease, Fabry disease
- Other causes: AIDS-related nephropathy, hepatitis

Figure 12.11. Approach to proteinuria.

Glomerular filtration barrier



Slit diaphragms

- Contain pores (≈40Å × 140Å) that limit passage of some proteins and other macromolecules

Visceral glomerular epithelial cell (podocyte) foot processes

GBN

- Retards the passage of proteins >100,000 Da
- Contains heparan sulfate proteoglycans that limit passage of negatively charged particles (e.g., albumin)

Capillary endothelial cell layer

- Heparan sulfate proteoglycans on surface of the endothelial cells limit passage of negatively charged particles (such as albumin)
- Fenestrations of ≈700Å allow the passage of water, urea, Na^+, glucose, and small proteins
- Proteins <20,000 Da freely cross the endothelial cell layer in general

The degree of proteinuria depends on the integrity of the glomerular filtration barrier (charge and size selectivity) and the intraglomerular (filtration) pressure.

Figure 12.12. Glomerular filtration barrier of macromolecules.

TABLE 12.7 • Clinical features of nephritic and nephritic syndromes

	Nephrotic	Nephritic
Onset	Slower	Rapid
Edema	+ + + +, all over	+ +
BP	Normal/low	Increased
JVP	Normal/low	Increased
Proteinuria	> 3 g/d	< 3 g/d
Hematuria	May occur	+ + +
Urine sediment	Hyaline casts, lipid droplets	RBC, WBC, RBC casts, granular casts
Albumin	↓↓↓	Normal/mild ↓
Creatinine	Normal/increased	Usually increased
Common 1° causes	Minimal change disease, focal segmental glomerulosclerosis, membranous nephropathy, congenital nephrotic syndrome, Alport disease	IgA nephropathy, Wegener granulomatosis, antiglomerular basement membrane disease, lupus nephritis, postinfectious glomerulonephritis, endocarditis, membranoproliferative glomerulonephritis
Common 2° causes	Diabetic nephropathy, amyloidosis, lupus nephritis, membranoproliferative glomerulonephritis, 2° membranous, 2° FSGS, HIV nephropathy, preeclampsia, malaria, syphilis	
Investigations	As appropriate: renal ultrasound, serologies for lupus, hepatitis C & B, syphilis, blood cultures, transesophageal echocardiogram, ANCA, anti-GBM Ab, HIV, kidney biopsy	

- If normotensive at low-dose ACEIs or ARBs as tolerated
- If fluid overload/edema at salt and water restrictions ± diuretics (with caution)
- If diabetic → tight glucose control
- Dietary protein restrictions of 0.8 to 1 g/kg/d (controversial)
- Consider treating 2° lipid abnormalities if persistent (particularly if other risk factors for CVD)
- Manage cardiovascular risk factors
- Consider anticoagulant prophylaxis if a second risk factor for venous thrombosis develops or serum albumin very low
- If membranous nephropathy, screen for malignancy, especially if older age or risk factors

HYPERNATREMIA

MCC OBJECTIVE

Based on Objective #99-1 (Hypernatremia) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Definition

- $Na^+ > 145$ mEq/L

Rationale

- Mainly occurs in patients who do not experience thirst, cannot communicate thirst (elderly, critically ill, infants)

CAUSAL CONDITIONS (Table 12.8)

TABLE 12.8 • Differential diagnosis/causal conditions of hypernatremia

Unreplaced Water Loss
• Skin: sweat (normal 500–700 mL/d, Na concentration 25–65 mEq/L), increases with fever, high temperatures, burns, exercise
• GI losses: vomiting, NG suction, osmotic diarrhea
• Urinary losses: diabetes insipidus, osmotic diuresis (glucose, mannitol, urea), postobstructive diuresis
• Insensible losses from airways
• Hypothalamic lesions resulting in hypodipsia, inability to communicate thirst (ICU patients, dementia, infant), or decreased thirst sensation (elderly)
Sodium Overload
• Salt poisoning: salt tablets
• Isotonic saline infusion with hypotonic fluid losses
• Hypertonic solutions (tube feeds, TPN)
• 1° hyperaldosteronism

APPROACH (Figure 12.13)

APPLIED SCIENTIFIC CONCEPTS

- Hypernatremia results from either loss of electrolyte-free water or sodium gain (less common).
- Physiologically salt intake or water losses are potent stimuli to thirst by increasing plasma osmolality and stimulation of hypothalamic osmoreceptors, which results in ADH release that prevents further derangement and maintains serum osmolality.
- Hypernatremia will develop only in individuals who cannot ask for/access water: elderly/critically ill/infants.

CLINICAL box

Overly rapid correction of hypernatremia may lead to cerebral edema.

Symptoms: impaired mental status, headaches, memory loss, seizures, coma

Consult/admit if:
- Serum $Na^+ > 150$ mEq/L
- Hypervolemic hypernatremia
- Severe dehydration
- Altered mental status

HYPONATREMIA

MCC OBJECTIVE

Based on Objective #99-2 (Hyponatremia) of *Objectives for the Qualifying Examination*, 3rd edition.

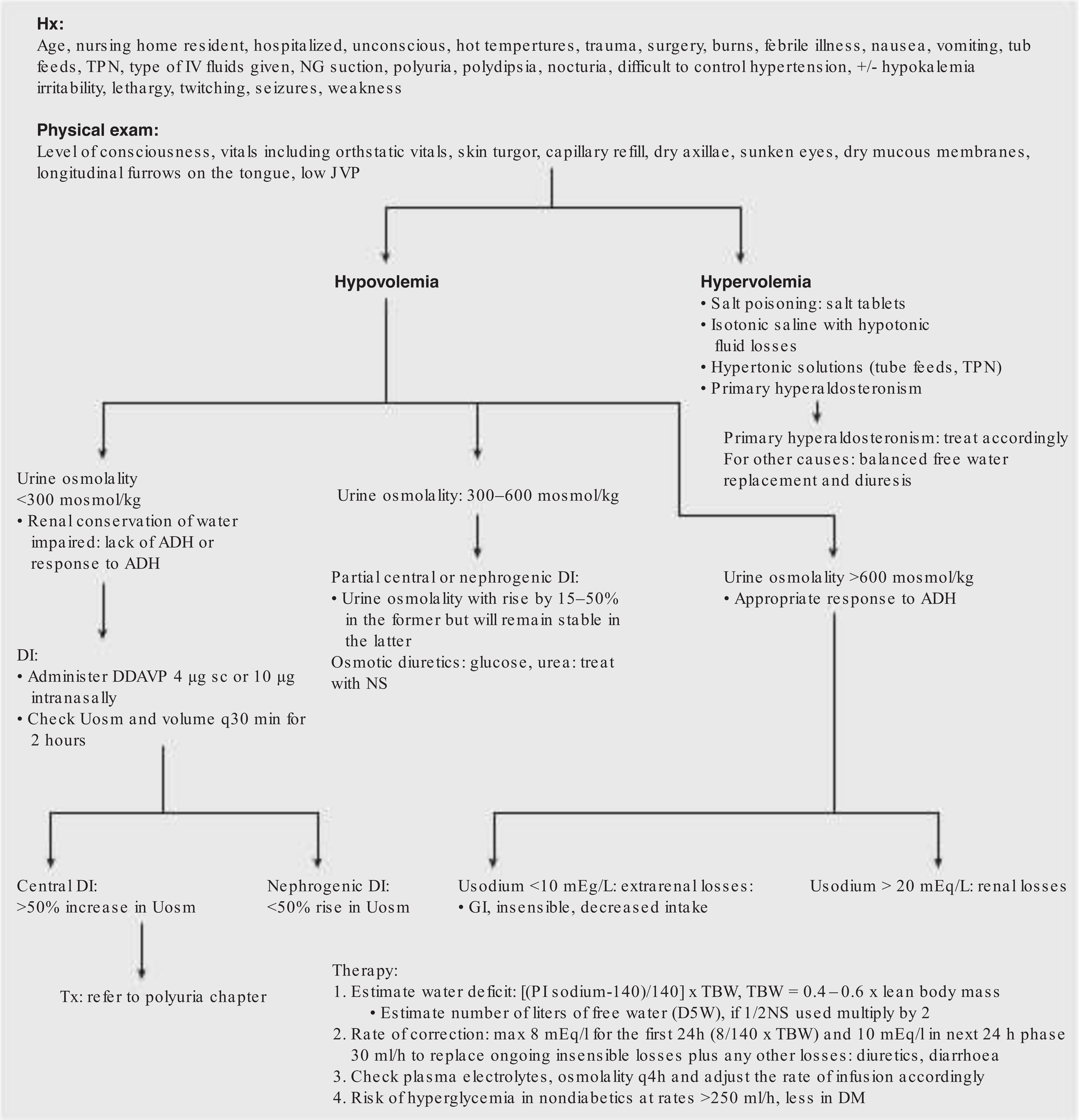
OVERVIEW

Rationale

- Frequent incidental finding in asymptomatic patients
- Most common electrolyte abnormality in hospitalized patients (2% prevalence)
- Severe (< 120 mmol/L) or abrupt hyponatremia → ↑ risk of neurologic complications (due to cerebral edema)
- Pediatric cases often iatrogenic

APPLIED SCIENTIFIC CONCEPTS

- Na^+ is the predominant ECF cation and key in determining plasma osmolality.
- Hyponatremia is usually associated with hypoosmolality, but may occur with normal or high osmolality.
- With hypoosmolality, the underlying mechanism of hyponatremia is an inability to excrete free water adequately, either due to a decreased effective circulating volume (Figure 12.13) or an increase in ADH (either appropriate or inappropriate).
- With normal or increased osmolality, serum sodium is "diluted."
- Volume status is important in assessing a hyponatremia patient:
  - Hypovolemic hyponatremia—the patient has lost both total body water (TBW) and total body sodium (TBNa), but relative sodium loss, or water gain (e.g., replacing electrolyte losses with free water), is greater.



Hx:
Age, nursing home resident, hospitalized, unconscious, hot tempertures, trauma, surgery, burns, febrile illness, nausea, vomiting, tub feeds, TPN, type of IV fluids given, NG suction, polyuria, polydipsia, nocturia, difficult to control hypertension, +/- hypokalemia irritability, lethargy, twitching, seizures, weakness

Physical exam:
Level of consciousness, vitals including orthstatic vitals, skin turgor, capillary refill, dry axillae, sunken eyes, dry mucous membranes, longitudinal furrows on the tongue, low JVP

Hypovolemia

Hypervolemia
- Salt poisoning: salt tablets
- Isotonic saline with hypotonic fluid losses
- Hypertonic solutions (tube feeds, TPN)
- Primary hyperaldosteronism

Primary hyperaldosteronism: treat accordingly
For other causes: balanced free water replacement and diuresis

Urine osmolality <300 mosmol/kg
- Renal conservation of water impaired: lack of ADH or response to ADH

Urine osmolality: 300–600 mosmol/kg

Urine osmolality >600 mosmol/kg
- Appropriate response to ADH

DI:
- Administer DDAVP 4 µg sc or 10 µg intranasally
- Check Uosm and volume q30 min for 2 hours

Partial central or nephrogenic DI:
- Urine osmolality with rise by 15–50% in the former but will remain stable in the latter

Osmotic diuretics: glucose, urea: treat with NS

Central DI:
>50% increase in Uosm

Nephrogenic DI:
<50% rise in Uosm

Usodium <10 mEg/L: extrarenal losses:
- GI, insensible, decreased intake

Usodium > 20 mEq/L: renal losses

Tx: refer to polyuria chapter

Therapy:
1. Estimate water deficit: [(Pl sodium-140)/140] x TBW, TBW = 0.4 – 0.6 x lean body mass
    - Estimate number of liters of free water (D5W), if 1/2NS used multiply by 2
2. Rate of correction: max 8 mEq/l for the first 24h (8/140 x TBW) and 10 mEq/l in next 24 h phase 30 ml/h to replace ongoing insensible losses plus any other losses: diuretics, diarrhoea
3. Check plasma electrolytes, osmolality q4h and adjust the rate of infusion accordingly
4. Risk of hyperglycemia in nondiabetics at rates >250 ml/h, less in DM

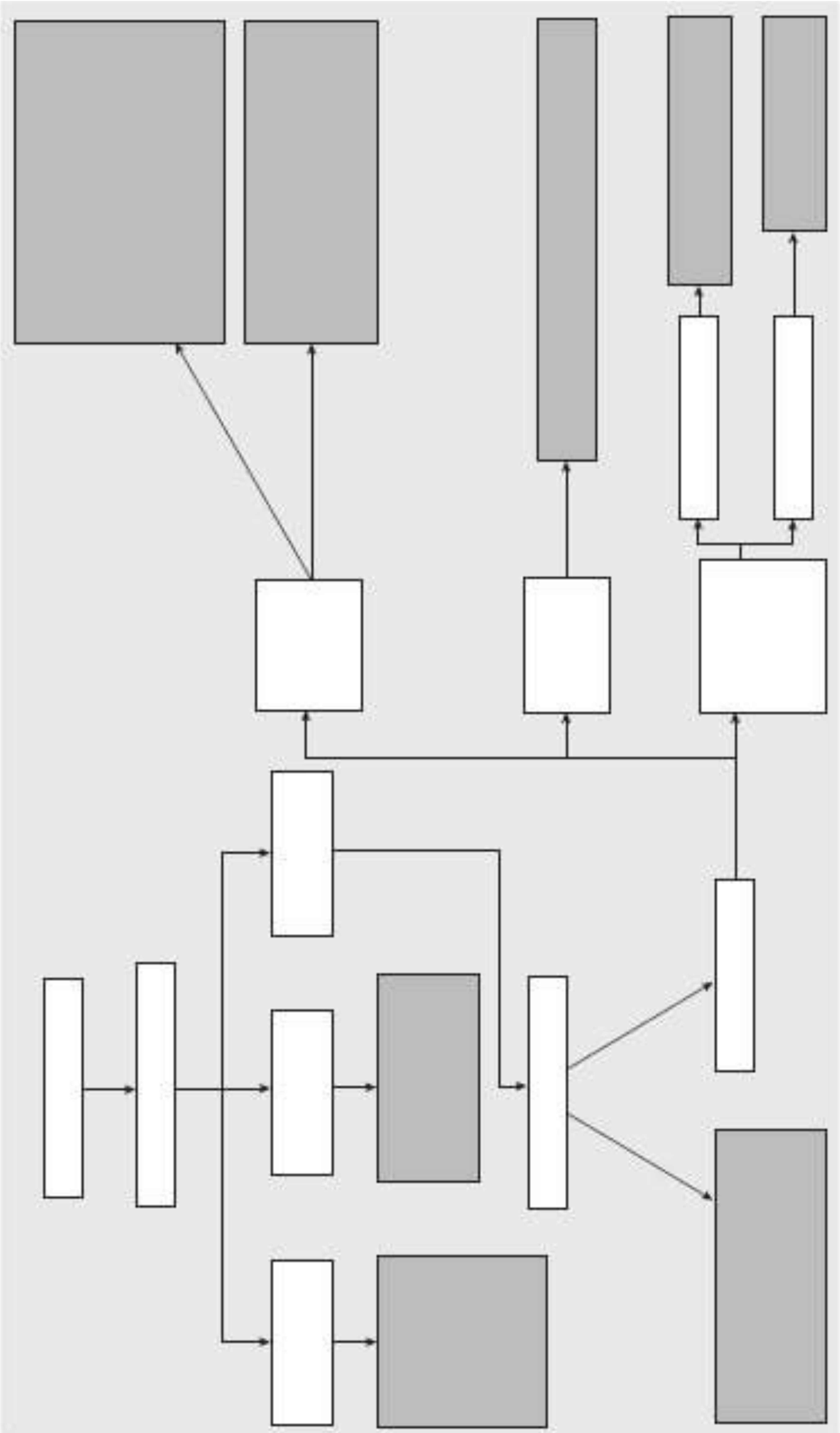
Figure 12.13. Approach to hypernatremia.

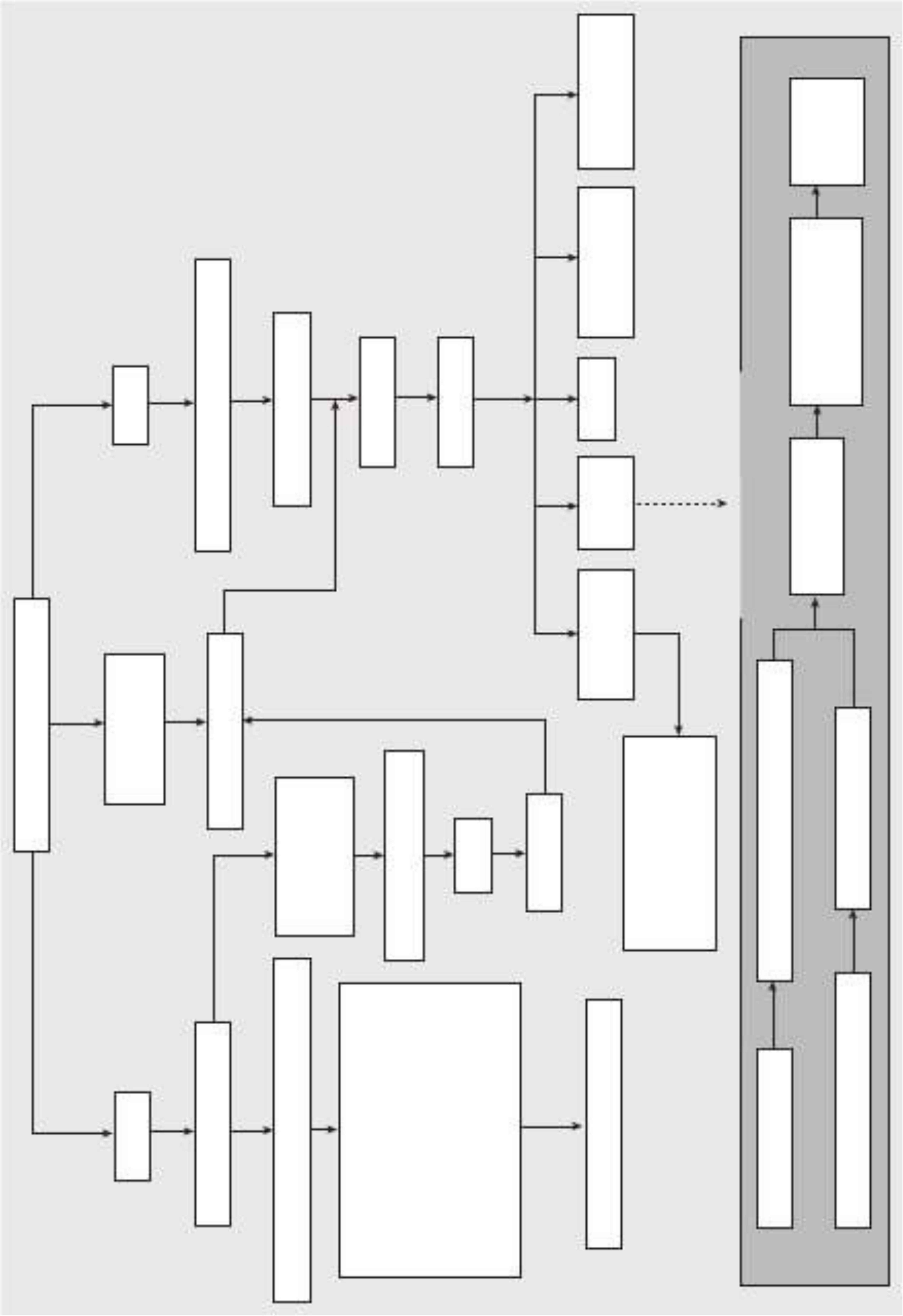
- Normovolemic patients have normal TBNa, but relative excess TBW.
- Hypervolemic patients have an increase in both TBNa and TBW, but a relative excess of water.

- Urine osmolality indicates whether ADH is present or suppressed.
- ADH is usually suppressed if UOsm < 100 mOsm/kg, SG < 1.003 (exceptions may be malnutrition/beer potomania or reset osmostat).

cAUSAl coNDITIoNS AND AppRoAch (Figure 12.14)

History (Figure 12.15)





- Recent fluid losses/shifts
- Use of hypotonic fluids
- Drugs (especially diuretics)
- Hx of CHF, cirrhosis, nephrotic syndrome
- Hx suggestive of possible SIADH

CLINICAL box

Hyponatremia

Serum Na^+ < 135 mmol/L; usually results from intake followed by inadequate excretion of free water

CLINICAL box

Serum $[Na^+] =$ Total Na^+ (mEq)/ECF

Plasma Osmolality

Plasma osmolality (mOsm/kg) = $2[Na^+] + [Glucose] + [Urea]$ (all units in mmol/L)

Physical Exam

- Neurologic status—mental status, muscle weakness
- Volume status
- **Note:** premenopausal women are particularly susceptible to the effects of cerebral edema

CLINICAL box

Patients may have multiple coexisting contributors to hyponatremia, for example, malignancy causing SIADH and adrenal insufficiency, which may require independent treatment strategies.

Symptoms of Acute versus Chronic Hyponatremia

- Acute
  - If mild (120–130 mmol/L) → asymptomatic or nausea, malaise, anorexia, headache, lethargy, weakness, confusion
  - If abrupt and severe (< 120 mmol/L) → delirium, neuromuscular hyperexcitability, seizures, coma, respiratory arrest, death
  - Complications → brainstem herniation; hypothalamic and posterior pituitary infarction
- Chronic
  - Cerebral adaptation → often asymptomatic (even with $[Na^+]$ as low as 110 mmol/L)
  - If symptomatic, nausea, fatigue, gait instability, amnesia, confusion, lethargy, muscle cramps

Management

- Step 1: determine plasma osmolality
- Step 2: if hypoosmolar, determine ECF volume
- Step 3: treat hyponatremia according to patient symptoms
- Step 4: correct underlying abnormality
- Figure 12.16

CLINICAL box

- Vaptans are a new class of medication that directly inhibits ADH.
- Vaptans are approved for use in euvolemic or hypervolemic hyponatremic patients in hospital—serum Na^+ must be monitored frequently on these medications.

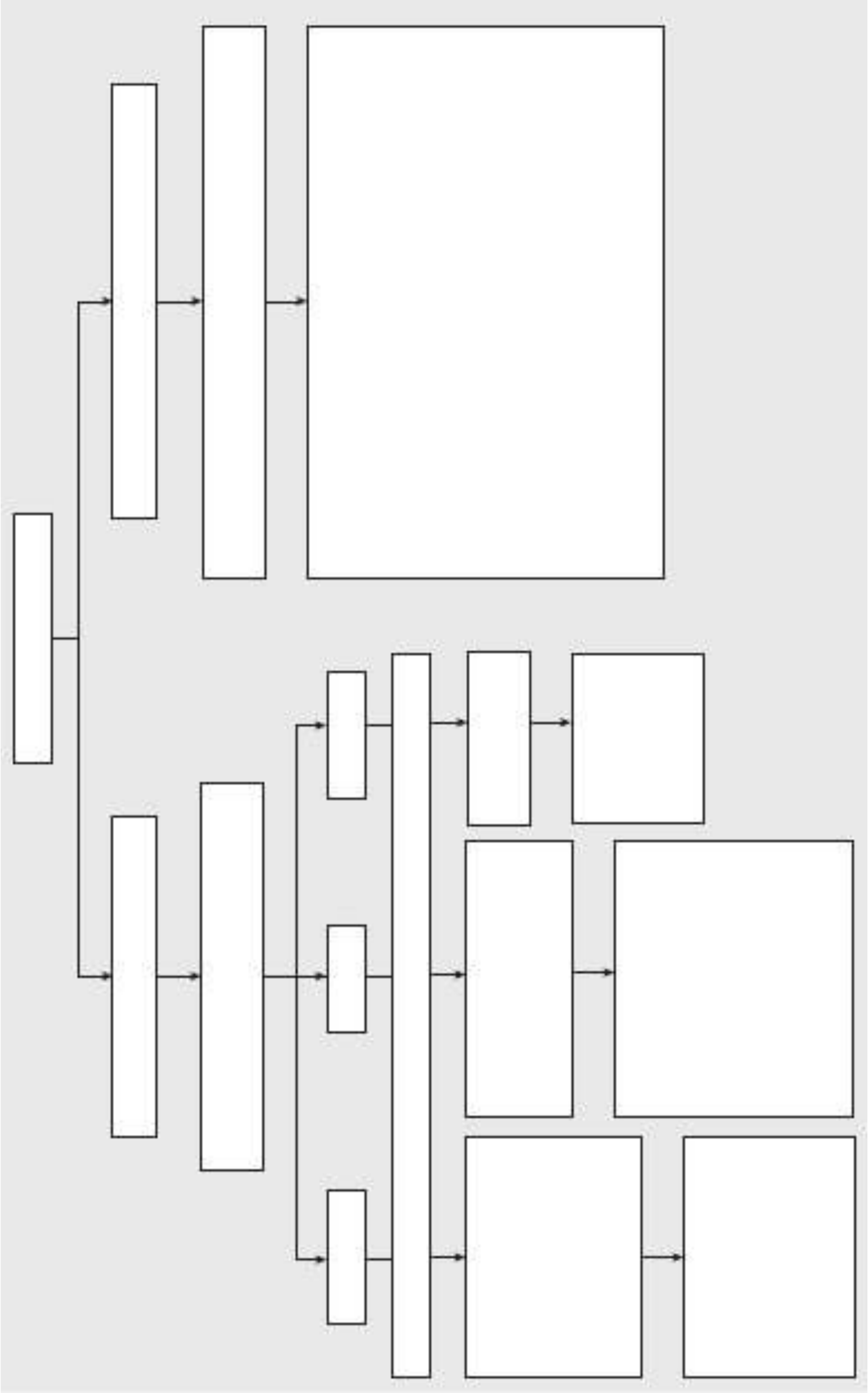
CLINICAL box

- If serum Na^+ rises by > 10 to 12 in 24 h, in some cases readministration of free water, or exogenous ADH, may be used to slow rate.
- Serum Na^+ and urine osmolality must be monitored frequently.

ACUTE RENAL FAILURE

MCC OBJECTIVE

Based on Objective #89-1 (Acute Kidney Injury [Anuria or Oliguria]) of *Objectives for the Qualifying Examination*, 3rd edition.



OVERVIEW

Definition

- Sudden, rapid, and potentially reversible (hours–weeks) fall in GFR, leading to accumulation of nitrogenous waste products
- Common clinical manifestations → azotemia (due to ↓ GFR, associated with ↑ urea and Cr) and often abnormal urine volume (anuria—urine output < 100 mL/24 h or oliguria—urine output between 100 and 400 mL/24 h)

APPLIED SCIENTIFIC CONCEPTS

- GFR = $K_f(\Delta P - \Delta\pi)$. Determinants of GFR → properties of the glomerular filtration barrier (surface area and permeability → ultrafiltration coefficient K_f), hydrostatic and oncotic pressure gradients (ΔP and $\Delta\pi$) between glomerular capillary and Bowman space.
- Tubuloglomerular feedback: Na^+ delivery to macula densa regulates afferent arteriolar tone. ↑ Delivery → vasoconstriction.
- Glomerulotubular balance: proximal tubule tends to reabsorb a constant proportion (rather than amount) of the glomerular filtrate.
- Renal portal circulation: afferent arteriole → glomerular capillaries → efferent arteriole → vasa recta.
- Systemic and local factors (sympathetic discharge, myogenic autoregulation, tubuloglomerular feedback, prostaglandins, angiotensin II) help maintain constant GFR through regulation of afferent and efferent arteriolar tones.
- Countercurrent flow in the vasa recta → Po_2 is higher in renal cortex and lower in renal medulla.
- Being located in outer medulla and having the highest rate of energy-dependent solute transport, the medullary portions of the proximal tubule and of the TAL are the most vulnerable to ischemic injury (ischemic ATN).

CAUSAL CONDITIONS (Figure 12.17)

APPROACH

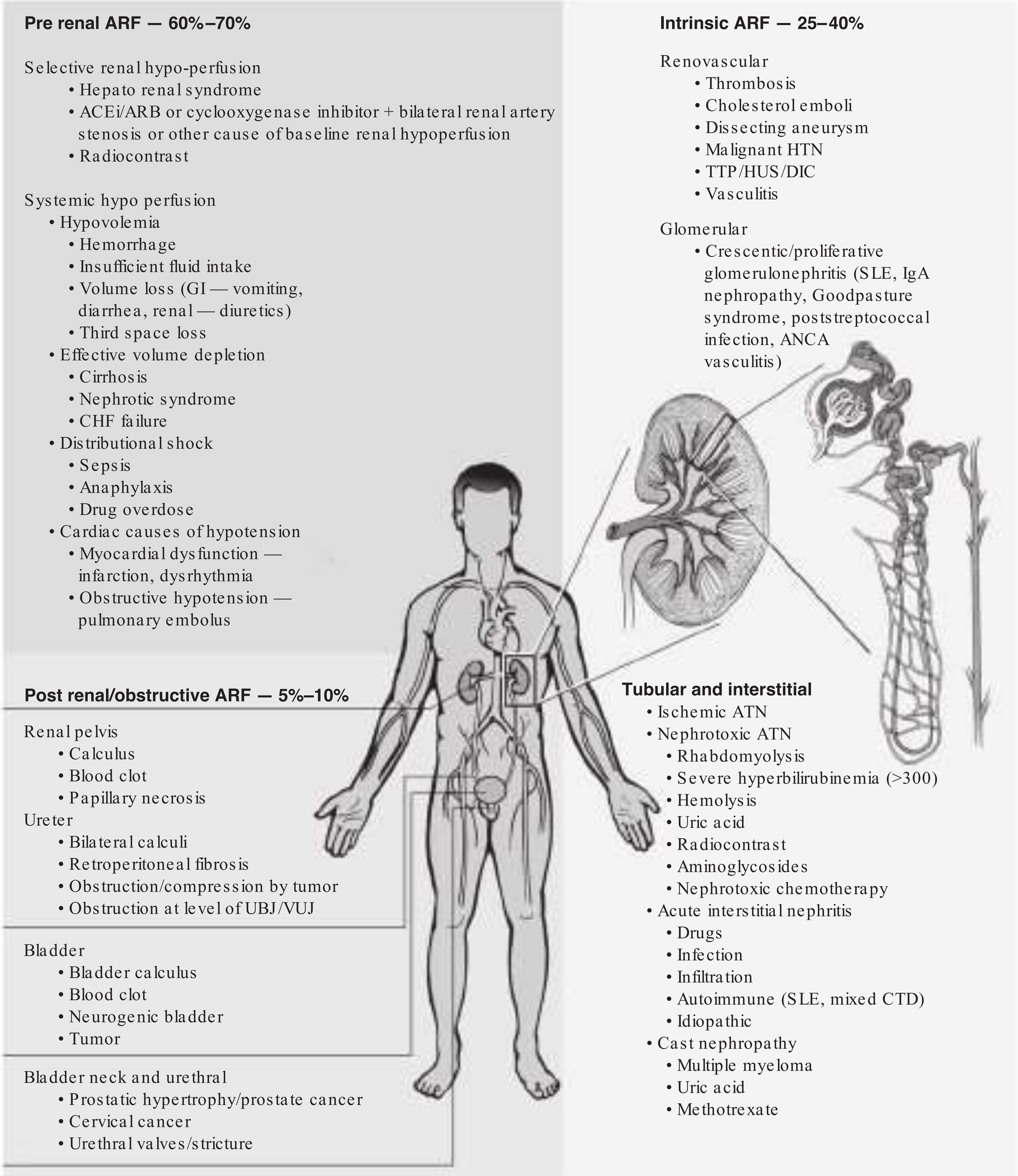
- Step 1A: differentiate acute versus chronic versus acute on chronic
  - Determine duration of problem
  - Review of lab records
  - Search for evidence of CRF (anemia, neuropathy, renal osteodystrophy, small scarred kidneys on ultrasound or renal isotope scan)
- Step 1B: differentiate prerenal versus intrinsic versus postrenal ARF and identify **cause** (Figure 12.18)
  - For complications and initial management of ARF, see Table 12.9.

CLINICAL box

Other Complications of ARF

- Anemia
- Leukocytosis
- Bleeding diathesis (2° to uremia-induced platelet dysfunction)
- Progress to CRF
- Uremic syndrome

- Step 2: eliminate offending agent(s)/initiate disease-specific therapies (Figure 12.19)
  - **Screen for/prevent/manage complications of ARF**
    - Monitor:
      - Electrolytes, calcium, phosphate
      - Volume status (weight, BP, signs of pulmonary/peripheral edema)
      - Acid–base balance
      - Clinical signs and lab findings suggestive of nitrogenous waste accumulation
      - Mental status



Pre renal ARF — 60%–70%

Selective renal hypo-perfusion
- Hepato renal syndrome
- ACEi/ARB or cyclooxygenase inhibitor + bilateral renal artery stenosis or other cause of baseline renal hypoperfusion
- Radiocontrast

Systemic hypo perfusion
- Hypovolemia
  - Hemorrhage
  - Insufficient fluid intake
  - Volume loss (GI — vomiting, diarrhea, renal — diuretics)
  - Third space loss
- Effective volume depletion
  - Cirrhosis
  - Nephrotic syndrome
  - CHF failure
- Distributional shock
  - Sepsis
  - Anaphylaxis
  - Drug overdose
- Cardiac causes of hypotension
  - Myocardial dysfunction — infarction, dysrhythmia
  - Obstructive hypotension — pulmonary embolus

Post renal/obstructive ARF — 5%–10%

Renal pelvis
- Calculus
- Blood clot
- Papillary necrosis

Ureter
- Bilateral calculi
- Retroperitoneal fibrosis
- Obstruction/compression by tumor
- Obstruction at level of UBJ/VUJ

Bladder
- Bladder calculus
- Blood clot
- Neurogenic bladder
- Tumor

Bladder neck and urethral
- Prostatic hypertrophy/prostate cancer
- Cervical cancer
- Urethral valves/stricture

Intrinsic ARF — 25–40%

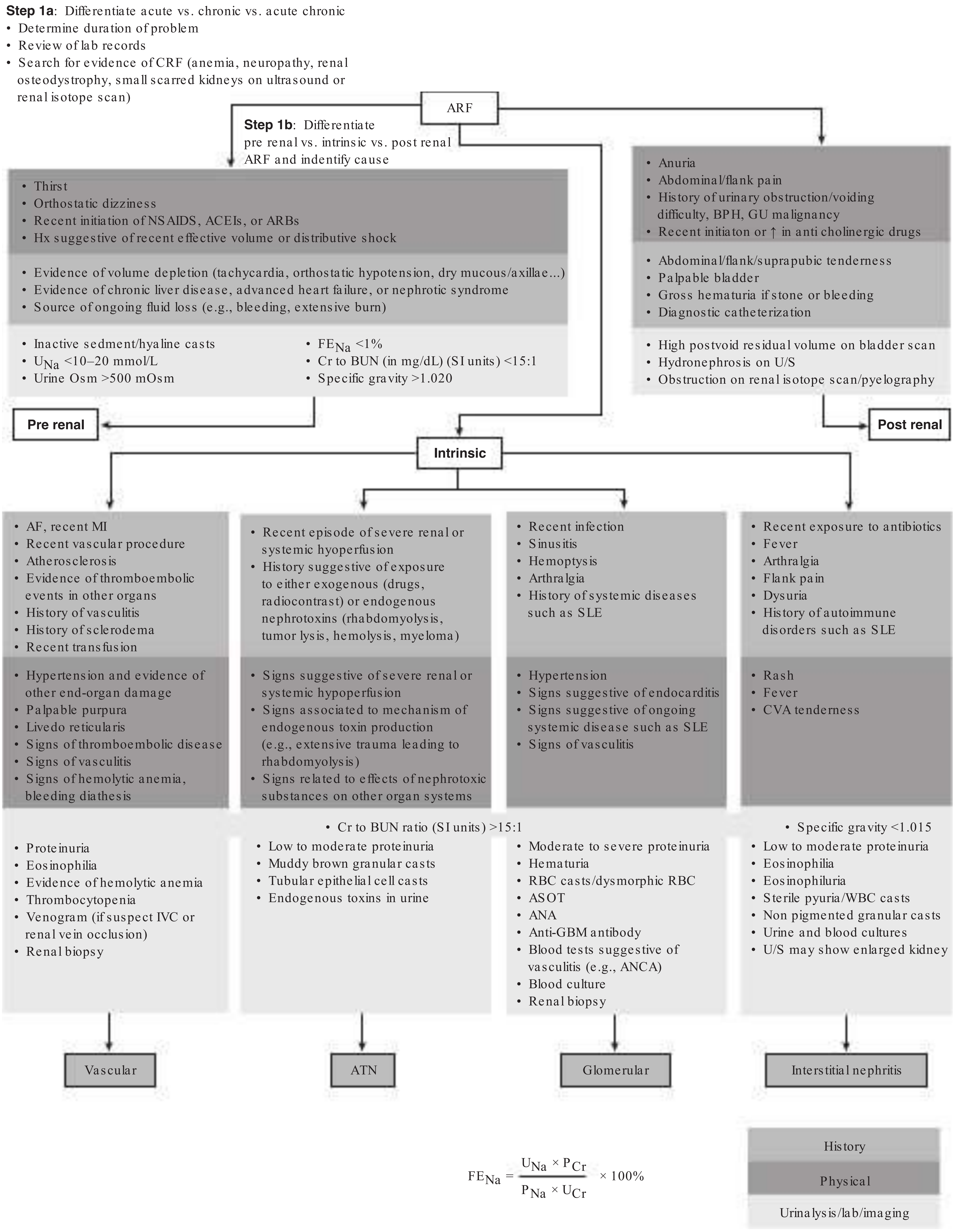
Renovascular
- Thrombosis
- Cholesterol emboli
- Dissecting aneurysm
- Malignant HTN
- TTP/HUS/DIC
- Vasculitis

Glomerular
- Crescentic/proliferative glomerulonephritis (SLE, IgA nephropathy, Goodpasture syndrome, poststreptococcal infection, ANCA vasculitis)

Tubular and interstitial
- Ischemic ATN
- Nephrotoxic ATN
  - Rhabdomyolysis
  - Severe hyperbilirubinemia (>300)
  - Hemolysis
  - Uric acid
  - Radiocontrast
  - Aminoglycosides
  - Nephrotoxic chemotherapy
- Acute interstitial nephritis
  - Drugs
  - Infection
  - Infiltration
  - Autoimmune (SLE, mixed CTD)
  - Idiopathic
- Cast nephropathy
  - Multiple myeloma
  - Uric acid
  - Methotrexate

Figure 12.17. Causal conditions of ARF.

- Indications for dialysis:
  - Refractory fluid overload
  - Refractory hyperkalemia (> 6.5 mEq/L) or rapidly progressive hyperkalemia
  - Metabolic acidosis (pH < 7.1)
  - Severe refractory hypercalcemia
  - Signs of uremia (pericarditis, encephalopathy)
  - Hyperthermia
  - Overdose with a dialyzable drug/toxin


Step 1a: Differentiate acute vs. chronic vs. acute chronic
• Determine duration of problem
• Review of lab records
• Search for evidence of CRF (anemia, neuropathy, renal osteodystrophy, small scarred kidneys on ultrasound or renal isotope scan)
ARF
Step 1b: Differentiate pre renal vs. intrinsic vs. post renal ARF and indentify cause
• Thirst
• Orthostatic dizziness
• Recent initiation of NSAIDS, ACEIs, or ARBs
• Hx suggestive of recent effective volume or distributive shock
• Evidence of volume depletion (tachycardia, orthostatic hypotension, dry mucous/axillae...)
• Evidence of chronic liver disease, advanced heart failure, or nephrotic syndrome
• Source of ongoing fluid loss (e.g., bleeding, extensive burn)
• Inactive sedment/hyaline casts
• U_Na <10–20 mmol/L
• Urine Osm >500 mOsm
• FE_Na <1%
• Cr to BUN (in mg/dL) (SI units) <15:1
• Specific gravity >1.020
Pre renal
• Anuria
• Abdominal/flank pain
• History of urinary obstruction/voiding difficulty, BPH, GU malignancy
• Recent initiaton or ↑ in anti cholinergic drugs
• Abdominal/flank/suprapubic tenderness
• Palpable bladder
• Gross hematuria if stone or bleeding
• Diagnostic catheterization
• High postvoid residual volume on bladder scan
• Hydronephrosis on U/S
• Obstruction on renal isotope scan/pyelography
Post renal
Intrinsic
• AF, recent MI
• Recent vascular procedure
• Atherosclerosis
• Evidence of thromboembolic events in other organs
• History of vasculitis
• History of sclerodema
• Recent transfusion
• Hypertension and evidence of other end-organ damage
• Palpable purpura
• Livedo reticularis
• Signs of thromboembolic disease
• Signs of vasculitis
• Signs of hemolytic anemia, bleeding diathesis
• Proteinuria
• Eosinophilia
• Evidence of hemolytic anemia
• Thrombocytopenia
• Venogram (if suspect IVC or renal vein occlusion)
• Renal biopsy
Vascular
• Recent episode of severe renal or systemic hyoperfusion
• History suggestive of exposure to either exogenous (drugs, radiocontrast) or endogenous nephrotoxins (rhabdomyolysis, tumor lysis, hemolysis, myeloma)
• Signs suggestive of severe renal or systemic hypoperfusion
• Signs associated to mechanism of endogenous toxin production (e.g., extensive trauma leading to rhabdomyolysis)
• Signs related to effects of nephrotoxic substances on other organ systems
• Cr to BUN ratio (SI units) >15:1
• Low to moderate proteinuria
• Muddy brown granular casts
• Tubular epithelial cell casts
• Endogenous toxins in urine
ATN
• Recent infection
• Sinusitis
• Hemoptysis
• Arthralgia
• History of systemic diseases such as SLE
• Hypertension
• Signs suggestive of endocarditis
• Signs suggestive of ongoing systemic disease such as SLE
• Signs of vasculitis
• Moderate to severe proteinuria
• Hematuria
• RBC casts/dysmorphic RBC
• ASOT
• ANA
• Anti-GBM antibody
• Blood tests suggestive of vasculitis (e.g., ANCA)
• Blood culture
• Renal biopsy
Glomerular
• Recent exposure to antibiotics
• Fever
• Arthralgia
• Flank pain
• Dysuria
• History of autoimmune disorders such as SLE
• Rash
• Fever
• CVA tenderness
• Specific gravity <1.015
• Low to moderate proteinuria
• Eosinophilia
• Eosinophiliuria
• Sterile pyuria/WBC casts
• Non pigmented granular casts
• Urine and blood cultures
• U/S may show enlarged kidney
Interstitial nephritis
History
Physical
Urinalysis/lab/imaging

$$FE_{Na} = \frac{U_{Na} \times P_{Cr}}{P_{Na} \times U_{Cr}} \times 100\%$$

Figure 12.18. Approach to ARF: differentiating types of ARF.

TABLE 12.9 • Complications and initial management of ARF

ARF Complication	Initial Management
Intravascular overload	Salt (1–2 g/d) and water (< 1 L/d) restriction Loop diuretics with or without thiazide
Hyponatremia	Free water restriction (both PO and IV)
Hyperkalemia	K^+ restriction Discontinue K^+ supplement and K^+ sparing diuretics Exchange resins Insulin + glucose Sodium bicarbonate Calcium gluconate (for cardioprotection)
Hyperphosphatemia	Restriction of dietary intake Phosphate-binding agents (PO)
Hypocalcemia	Calcium replacement (IP or IV or PO)
Hypermagnesemia	Discontinue Mg^{2+}-containing antacids
Hyperuricemia	Provide sufficient calorie intake to avoid catabolism
Metabolic acidosis	Protein restriction (0.6 g/kg/d, rich in essential amino acids)

CHRONIC RENAL FAILURE

MCC OBJECTIVE

Based on Objective #89-2 (Chronic Kidney Injury) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Definition

- Evidence of renal damage **or** moderately to severely impaired GFR (< 60 mL/min) for at least 3 mo
- CRF = chronic renal disease = CKD (most widely used and accepted terminology)

Cockcroft-Gault equation:

$$\text{GRF} \sim \text{estimated Cr clearance in mL/min/1.73m}^2 = \frac{(140 - \text{age}) \times \text{weight in kg}}{P_{Cr}\,\text{in}\ \mu\text{mol/L}\,(\times 1.2\ \text{if male})}$$

- For stages of CKD, see Table 12.10.

Modification of Diet in Renal Disease (MDRD) equation:

$$\text{GRF} \sim \text{Estimated Cr clearance in mL/min/1.73 m}^2 = 175 \times P_{Cr}^{-1.154} \times \text{Age}^{-0.203} \times 0.742\ \text{if female} \times 1.210\ \text{if African American}$$

APPLIED SCIENTIFIC CONCEPTS

Renal Functions

- Maintain consistency of ECF volume (thus regulating BP) and osmolality through handling of NaCl and free water
- Produce erythropoietin, which stimulates production of RBC by bone marrow
- Maintain calcium homeostasis through activation of vitamin D and tubular handling of calcium and phosphate under the influence of PTH
- Maintain electrolyte balance through selective tubular handling
- Contribute to maintenance of acid–base balance through excretion of H^+ and recovery of HCO_3^-

Kidneys compensate for loss of nephrons through hyperfiltration by remaining nephrons mediated through ↑ filtration pressure (thereby ↑ filtration rate) in those nephrons. Progressive renal failure eventually develops as long-term damage occurs due to ↑ excretory burdens and hypertensive injury to surviving nephrons.

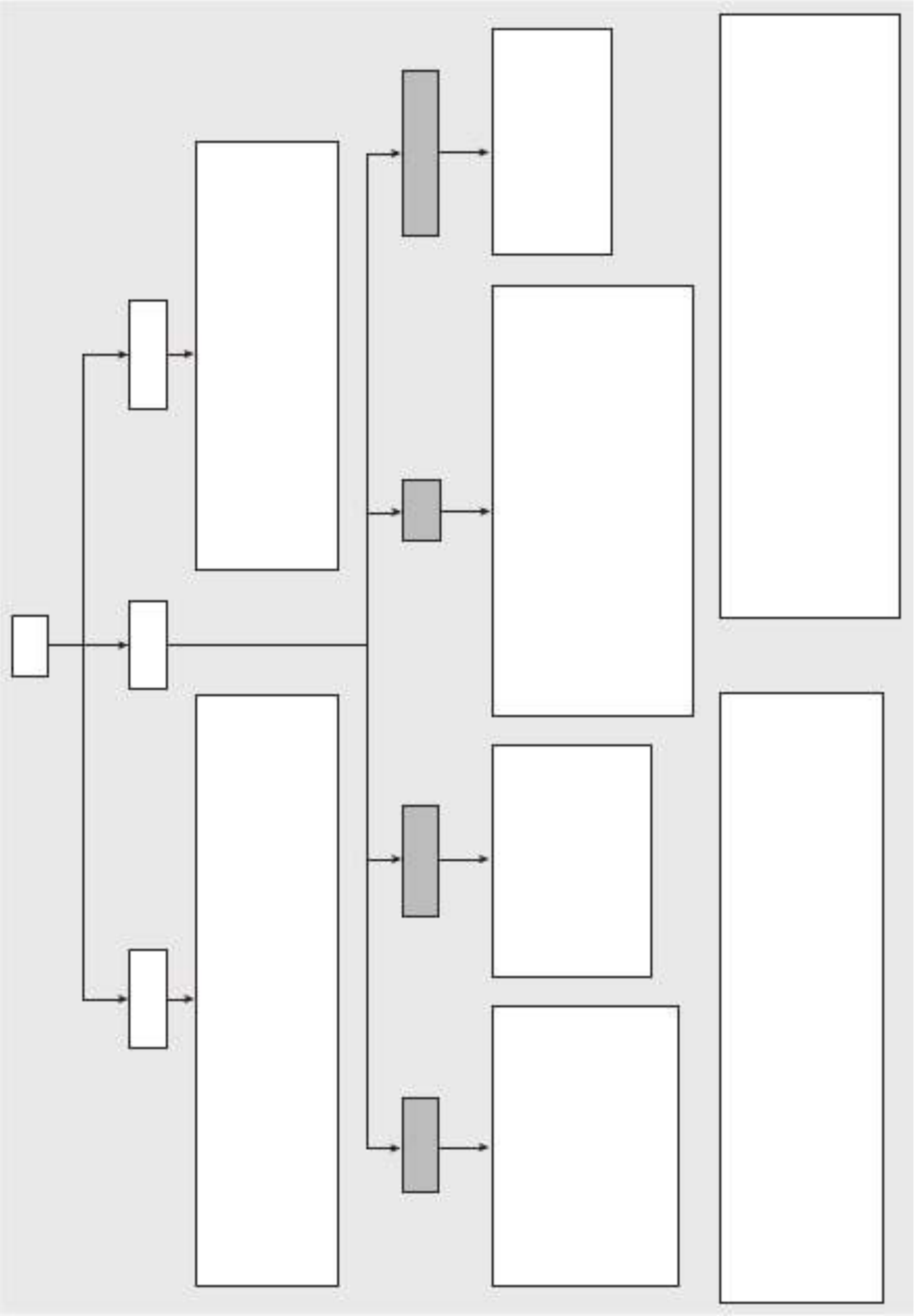
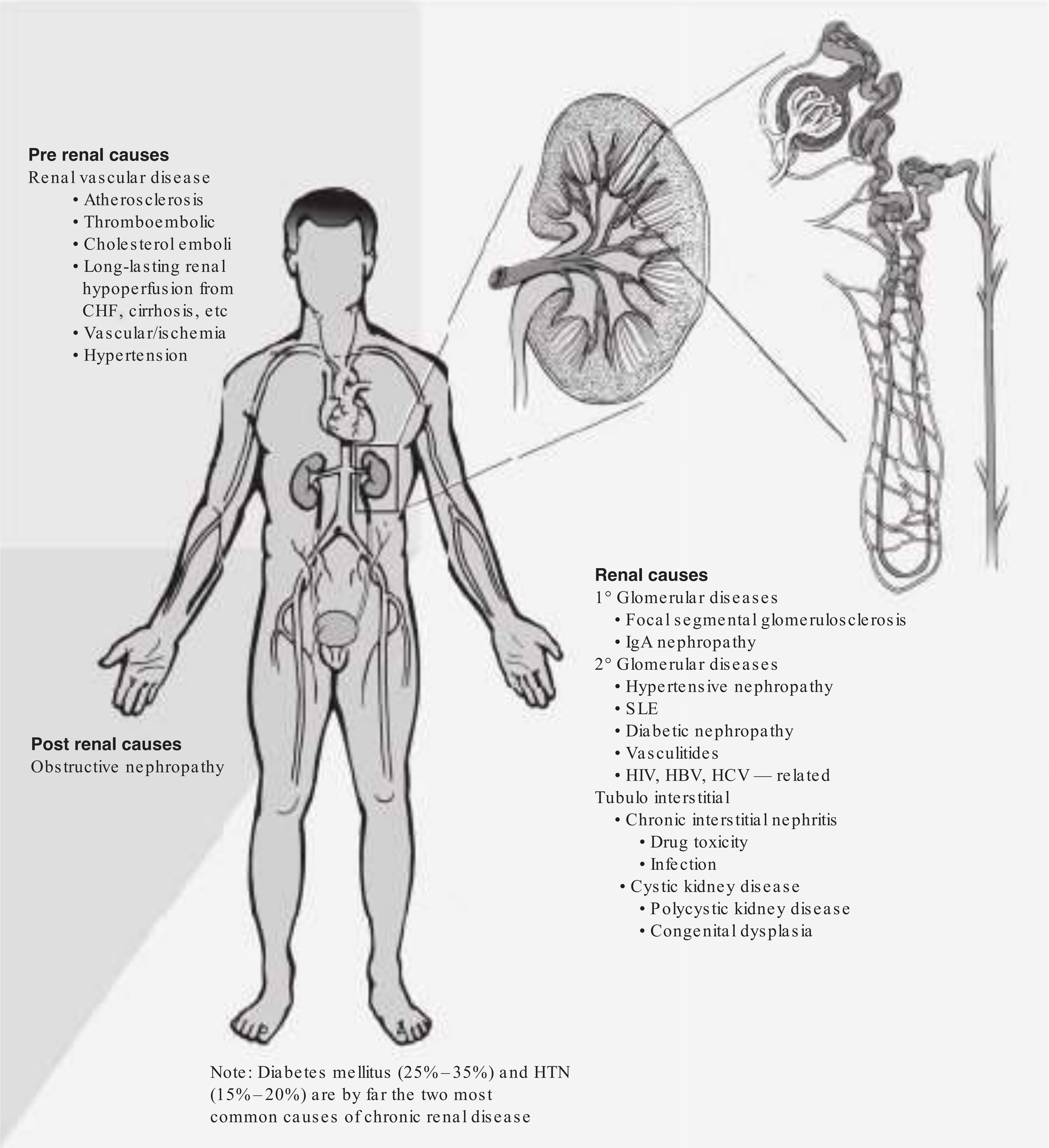


TABLE 12.10 • Stages of CKD (NKF KDOQI clinical practice guidelines for CKD)

Stage	GFR (mL/min/1.73 m^2)	Note
1	≥ 90	Normal to ↑ GFR with evidence of kidney damage
2	60–89	Mildly ↓ GFR with evidence of kidney damage
3	30–59	Moderately ↓ GFR
4	15–29	Severely ↓ GFR
5	< 15 or dialysis	ESRD or renal failure

Reprinted with permission from National Kidney Foundation. KDOQI clinical practice guideline for diabetes and CKD: 2012 update. Am J Kidney Dis. 2012;60(5):850–886.

CAUSAL CONDITIONS (Figure 12.20)



Pre renal causes
Renal vascular disease
- Atherosclerosis
- Thromboembolic
- Cholesterol emboli
- Long-lasting renal hypoperfusion from CHF, cirrhosis, etc
- Vascular/ischemia
- Hypertension

Renal causes
1° Glomerular diseases
- Focal segmental glomerulosclerosis
- IgA nephropathy

2° Glomerular diseases
- Hypertensive nephropathy
- SLE
- Diabetic nephropathy
- Vasculitides
- HIV, HBV, HCV — related

Tubulo interstitial
- Chronic interstitial nephritis
  - Drug toxicity
  - Infection
- Cystic kidney disease
  - Polycystic kidney disease
  - Congenital dysplasia

Post renal causes
Obstructive nephropathy

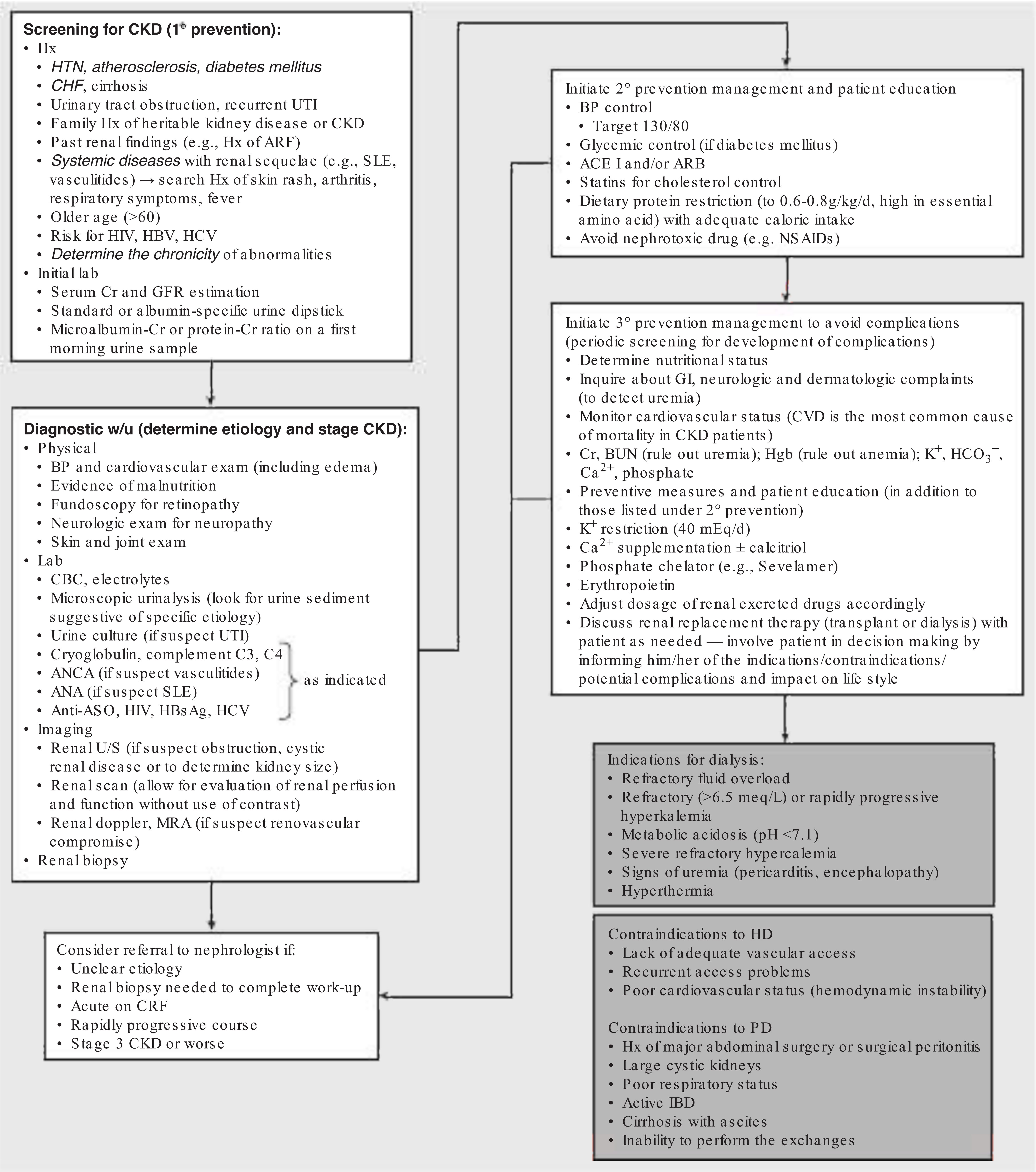
Note: Diabetes mellitus (25%–35%) and HTN (15%–20%) are by far the two most common causes of chronic renal disease

Figure 12.20. Causal condition of CRF.

C_2 L E O

- Discuss and respect patient preferences before initiating any treatment.
- Renal replacement therapy: high availability in Canada; lifesaving; but may not benefit every patient to the same extent and not always appropriate to be initiated or continued; treat each case individually.
- One important reason for nonreferral by 1° care physicians to nephrologists for dialysis consideration is patient refusal.
- On the basis of the principle of autonomy and the rights to self-determination, a competent patient has the personal and legal right to refuse or withdraw from dialysis. This right must be respected.
- Voluntary, full, and honest informed consent is essential in helping patient in end-of-life decision making.

APPROACH (Figure 12.21)



Screening for CKD (1° prevention):
- Hx
  - *HTN, atherosclerosis, diabetes mellitus*
  - *CHF*, cirrhosis
  - Urinary tract obstruction, recurrent UTI
  - Family Hx of heritable kidney disease or CKD
  - Past renal findings (e.g., Hx of ARF)
  - *Systemic diseases* with renal sequelae (e.g., SLE, vasculitides) → search Hx of skin rash, arthritis, respiratory symptoms, fever
  - Older age (>60)
  - Risk for HIV, HBV, HCV
  - *Determine the chronicity* of abnormalities
- Initial lab
  - Serum Cr and GFR estimation
  - Standard or albumin-specific urine dipstick
  - Microalbumin-Cr or protein-Cr ratio on a first morning urine sample

Diagnostic w/u (determine etiology and stage CKD):
- Physical
  - BP and cardiovascular exam (including edema)
  - Evidence of malnutrition
  - Fundoscopy for retinopathy
  - Neurologic exam for neuropathy
  - Skin and joint exam
- Lab
  - CBC, electrolytes
  - Microscopic urinalysis (look for urine sediment suggestive of specific etiology)
  - Urine culture (if suspect UTI)
  - Cryoglobulin, complement C3, C4
  - ANCA (if suspect vasculitides)
  - ANA (if suspect SLE)
  - Anti-ASO, HIV, HBsAg, HCV

  } as indicated
- Imaging
  - Renal U/S (if suspect obstruction, cystic renal disease or to determine kidney size)
  - Renal scan (allow for evaluation of renal perfusion and function without use of contrast)
  - Renal doppler, MRA (if suspect renovascular compromise)
- Renal biopsy

Consider referral to nephrologist if:
- Unclear etiology
- Renal biopsy needed to complete work-up
- Acute on CRF
- Rapidly progressive course
- Stage 3 CKD or worse

Initiate 2° prevention management and patient education
- BP control
  - Target 130/80
- Glycemic control (if diabetes mellitus)
- ACE I and/or ARB
- Statins for cholesterol control
- Dietary protein restriction (to 0.6-0.8g/kg/d, high in essential amino acid) with adequate caloric intake
- Avoid nephrotoxic drug (e.g. NSAIDs)

Initiate 3° prevention management to avoid complications (periodic screening for development of complications)
- Determine nutritional status
- Inquire about GI, neurologic and dermatologic complaints (to detect uremia)
- Monitor cardiovascular status (CVD is the most common cause of mortality in CKD patients)
- Cr, BUN (rule out uremia); Hgb (rule out anemia); K^+, HCO_3^-, Ca^{2+}, phosphate
- Preventive measures and patient education (in addition to those listed under 2° prevention)
- K^+ restriction (40 mEq/d)
- Ca^{2+} supplementation ± calcitriol
- Phosphate chelator (e.g., Sevelamer)
- Erythropoietin
- Adjust dosage of renal excreted drugs accordingly
- Discuss renal replacement therapy (transplant or dialysis) with patient as needed — involve patient in decision making by informing him/her of the indications/contraindications/potential complications and impact on life style

Indications for dialysis:
- Refractory fluid overload
- Refractory (>6.5 meq/L) or rapidly progressive hyperkalemia
- Metabolic acidosis (pH <7.1)
- Severe refractory hypercalemia
- Signs of uremia (pericarditis, encephalopathy)
- Hyperthermia

Contraindications to HD
- Lack of adequate vascular access
- Recurrent access problems
- Poor cardiovascular status (hemodynamic instability)

Contraindications to PD
- Hx of major abdominal surgery or surgical peritonitis
- Large cystic kidneys
- Poor respiratory status
- Active IBD
- Cirrhosis with ascites
- Inability to perform the exchanges

Figure 12.21. Approach to CRF.

HEMATURIA

MCC OBJECTIVE

Based on Objective #8 (Blood in Urine/Hematuria) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Definition

- > 2 RBCs per HPF (high power field)
- **Microhematuria:** presence of RBCs in urine without visible change in urine color
- **Macrohematuria:** red or brownish urine
- **Persistent hematuria:** hematuria present on at least two urine samples at least 1 mo apart

CAUSAL CONDITIONS (Table 12.11)

TABLE 12.11 • Differential diagnosis/causal conditions of hematuria
Dyes: Medications: doxorubicin, chloroquine, deferoxamine, ibuprofen, iron sorbitol, nitrofurantoin, rifampin, phenolphthalein, phenazopyridine Food dyes: beets, blackberries, food coloring Metabolites: bile pigments, homogentisic acid, methemoglobin, porphyrin, tyrosinosis
Pigmenturia: Hemoglobin Myoglobin
True hematuria: Fever, exercise—often transient, anticoagulants Glomerular: Isolated hematuria: IgA nephropathy, thin basement membrane syndrome, loin-pain hematuria syndrome, hereditary nephritis—Alport syndrome Nephritic syndromes: anti-GBM disease, Wegener granulomatosis and microscopic polyangiitis, immune-complex GNs: postinfectious GN, cryoglobulinemia, SLE, IgA nephropathy Multiple myeloma Renal: Hypercalciuria, hyperuricosuria, medullary sponge kidney, renal pelvis stones Tumors: benign such as angiomyolipoma, malignant: RCC, TCC PCKD Malignant hypertension Vascular: AVM, nutcracker syndrome, renal vein thrombosis, renal artery embolism Sickle cell disease Infection (bacterial, viral, fungal, TB) Tubulointerstitial diseases Ureter: Infection (bacterial, fungal, TB), stone, tumor, postsurgical stricture, post recent instrumentation, endometriosis Bladder: Infection (bacterial, fungal, TB, schistosomiasis), stone, tumor, noninfectious cystitis: post radiation, post cyclophosphamide, idiopathic; endometriosis Prostate and urethra: BPH, prostate cancer, post-TURP, urethral strictures, urethritis, trauma, postcatheterization
Mimics of hematuria: Contamination of urine with menstruation, GI bleed, atrophic vaginitis

APPROACH

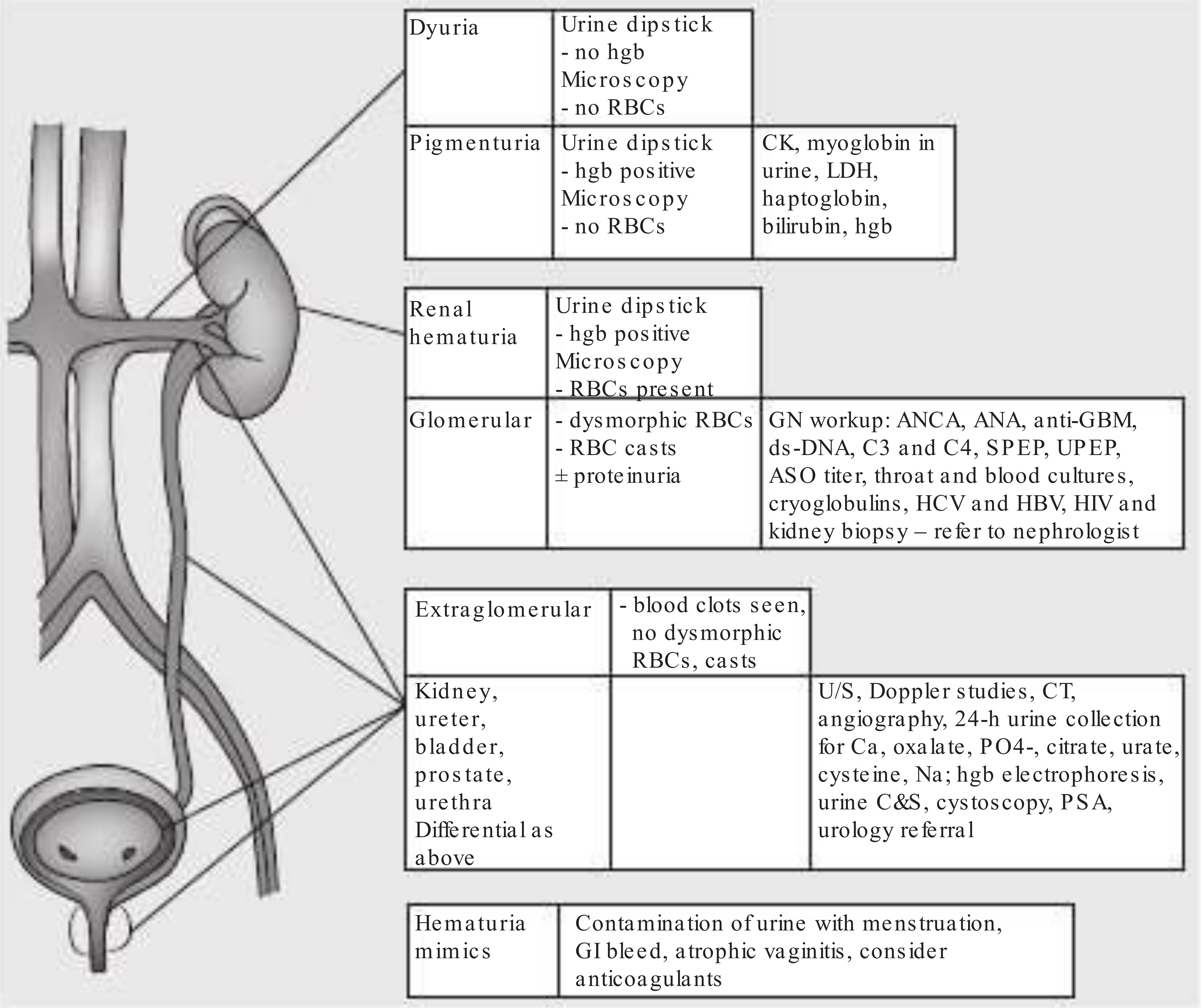
History

- Urine color, blood clots, diet, medications, muscle pain or weakness, paleness, jaundice, recent fever, exercise, menstrual period, family Hx, constitutional symptoms, arthralgias, arthritis, rashes, nasal discharge, bleeding, hemoptysis, risk factors for hepatitis, symptoms of BPH, Hx of stones, flank pains, ethnicity, recent GU surgery, instrumentation

Physical Exam

- Jaundice, rashes, joint swelling, palpable kidneys, costovertebral angle tenderness, prostate exam

Investigations (Figures 12.22 and 12.23)



Dyuria	Urine dipstick - no hgb Microscopy - no RBCs	
Pigmenturia	Urine dipstick - hgb positive Microscopy - no RBCs	CK, myoglobin in urine, LDH, haptoglobin, bilirubin, hgb

Renal hematuria	Urine dipstick - hgb positive Microscopy - RBCs present	
Glomerular	- dysmorphic RBCs - RBC casts ± proteinuria	GN workup: ANCA, ANA, anti-GBM, ds-DNA, C3 and C4, SPEP, UPEP, ASO titer, throat and blood cultures, cryoglobulins, HCV and HBV, HIV and kidney biopsy – refer to nephrologist

Extraglomerular	- blood clots seen, no dysmorphic RBCs, casts	
Kidney, ureter, bladder, prostate, urethra Differential as above		U/S, Doppler studies, CT, angiography, 24-h urine collection for Ca, oxalate, PO4-, citrate, urate, cysteine, Na; hgb electrophoresis, urine C&S, cystoscopy, PSA, urology referral

Hematuria mimics	Contamination of urine with menstruation, GI bleed, atrophic vaginitis, consider anticoagulants

Figure 12.22. Investigations for hematuria.

CLINICAL box

All patients with hematuria should have urine culture to exclude infection and should be treated if positive. Recheck urine in 6 wk for resolution of hematuria.

Other causes of transient hematuria may be fever, exercise, trauma, and endometriosis.

All patients who have no evidence of glomerular disease and hematuria unexplained by urine cultures and imaging should have cystoscopy to rule out malignancy!

Do not assume that anticoagulants are the sole reason for hematuria—this is diagnosis of exclusion!

CLINICAL box

Recurrent Nephrolithiasis

Investigations: stone analysis if possible, 24-h urine collection for urine volume, pH, calcium, phosphorus, oxalate, citrate, urate, cysteine, sodium; urine cultures

Management: increase fluid intake to at least 2 L/d (most important), dietary modifications (refer to dietitian), hydrochlorothiazide for hypercalciuria, citrate for hypocitraturia, allopurinol for hyperuricosuria

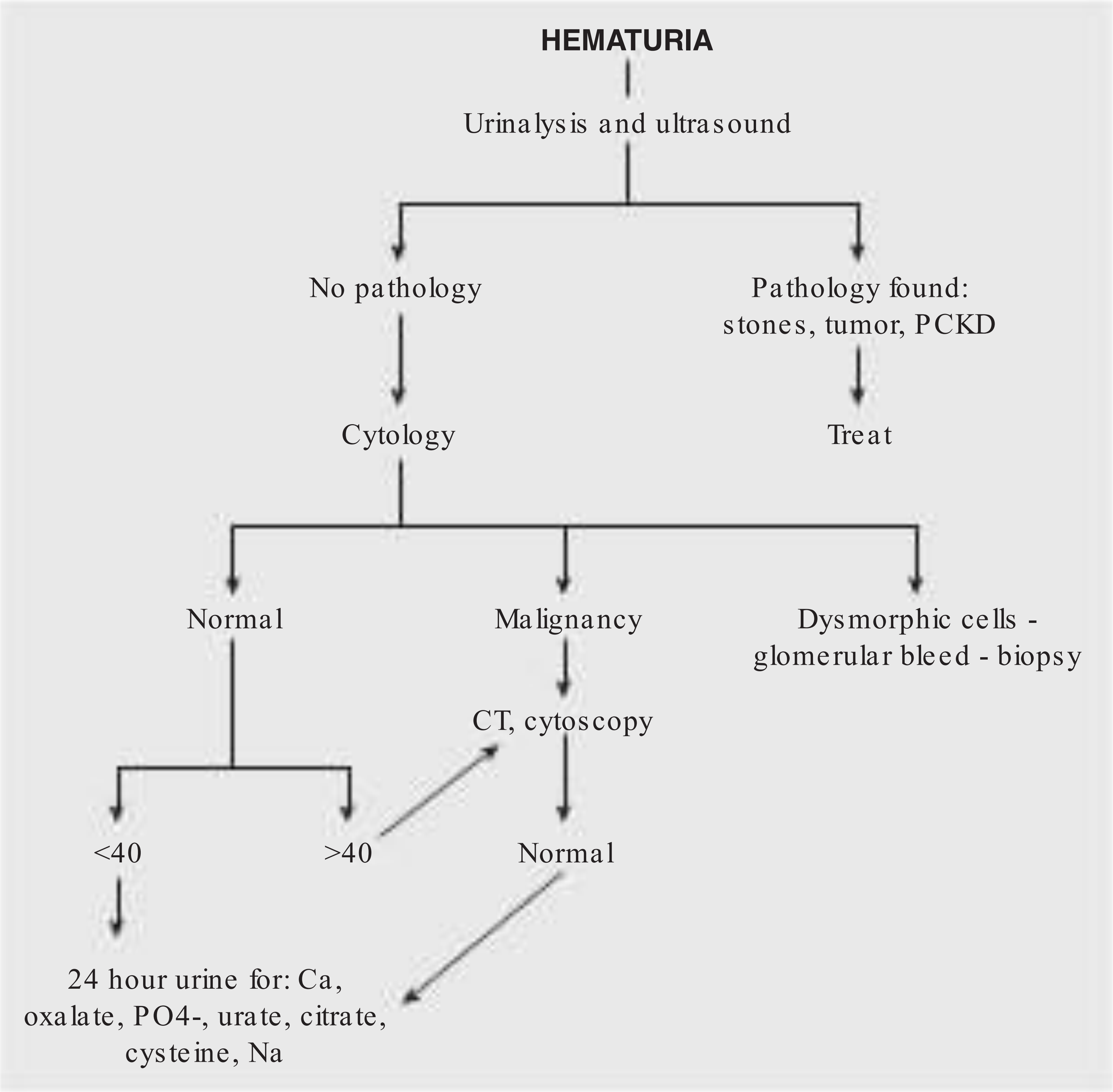

HEMATURIA
Urinalysis and ultrasound
No pathology
Pathology found: stones, tumor, PCKD
Cytology
Treat
Normal
Malignancy
Dysmorphic cells - glomerular bleed - biopsy
CT, cytoscopy
<40
>40
Normal
24 hour urine for: Ca, oxalate, PO4-, urate, citrate, cysteine, Na

Figure 12.23. Approach to hematuria.

APPLIED SCIENTIFIC CONCEPTS

- **Urine dipstick:** gold standard for detection of hematuria, very sensitive (detects 1–2 RBCs/HPF), detects hematuria and dysuria but is negative in pigmenturia
- **Urine microscopy:** will differentiate hematuria from dysuria by identifying RBCs
- **Glomerular hematuria:** results from a process involving glomerular structure and is characterized by dysmorphic RBCs (acanthocytes), RBC casts, proteinuria, no blood clots
- **Extraglomerular hematuria:** none of the above except of some proteinuria (but usually less than in glomerular bleed), blood clots

POLYURIA AND POLYDIPSIA

MCC OBJECTIVE

Based on Objective #110-2 (Polyuria and/or Polydipsia) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Definition

- Polyuria: > 3 L urine output/24 h in adults and 2 L/m^2 in children
- Polydipsia: increased thirst and water intake

Rationale

It is not a common presenting symptom; however, it may represent a serious condition. It may be confused with urinary frequency.

CAUSAL CONDITIONS (Table 12.12)

TABLE 12.12 • Conditions causing polyuria

I. **Water diuresis:** urine osmolality < 250 mOsm/kg (increased free water excretion either secondary to increased intake or reabsorption problem):
   1. 1° polydipsia
   2. Hypoosmolar fluid load
   3. Central DI
   4. Nephrogenic DI

II. **Osmotic diuresis:** urine osmolality > 300 mOsm/kg (increased osmolar excretion that draws water with it):
   1. Glucose
   2. Mannitol
   3. Urea: postobstruction and high protein feeds
   4. Iso/hyperosmotic fluid loads

Causes of Central DI (Figure 12.24)

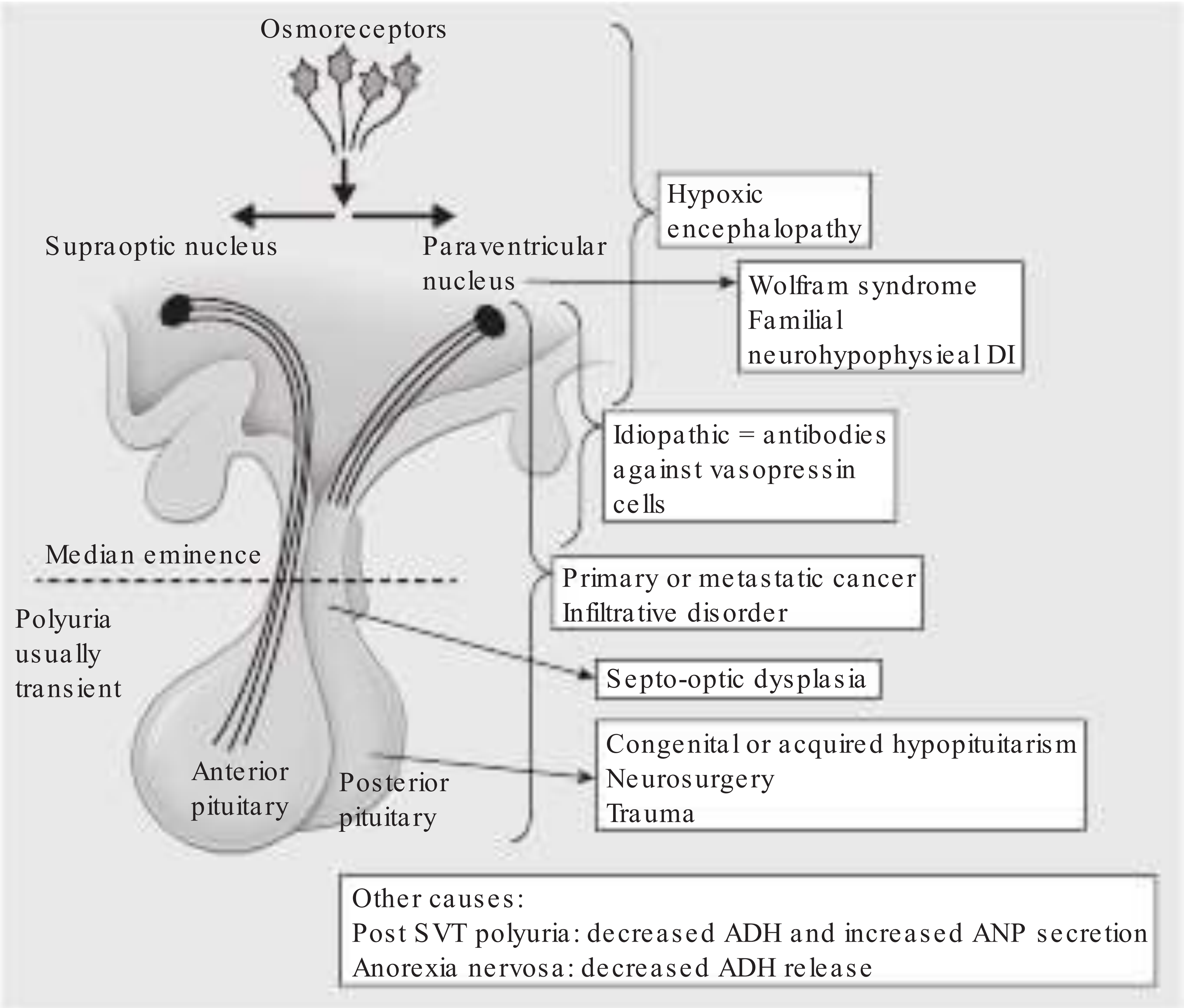

Osmoreceptors
Supraoptic nucleus
Paraventricular nucleus
Hypoxic encephalopathy
Wolfram syndrome
Familial neurohypophysieal DI
Idiopathic = antibodies against vasopressin cells
Median eminence
Primary or metastatic cancer
Infiltrative disorder
Polyuria usually transient
Septo-optic dysplasia
Anterior pituitary
Posterior pituitary
Congenital or acquired hypopituitarism
Neurosurgery
Trauma
Other causes:
Post SVT polyuria: decreased ADH and increased ANP secretion
Anorexia nervosa: decreased ADH release

Figure 12.24. Causes of central DI.

APPROACH (Figure 12.26)

APPLIED SCIENTIFIC CONCEPTS

- ADH is produced by the magnocellular neurons of supraoptic and paraventricular nuclei in the hypothalamus and transported via their dendrites to the posterior pituitary where it is released into the bloodstream.

Causes of Nephrogenic DI (Figure 12.25)

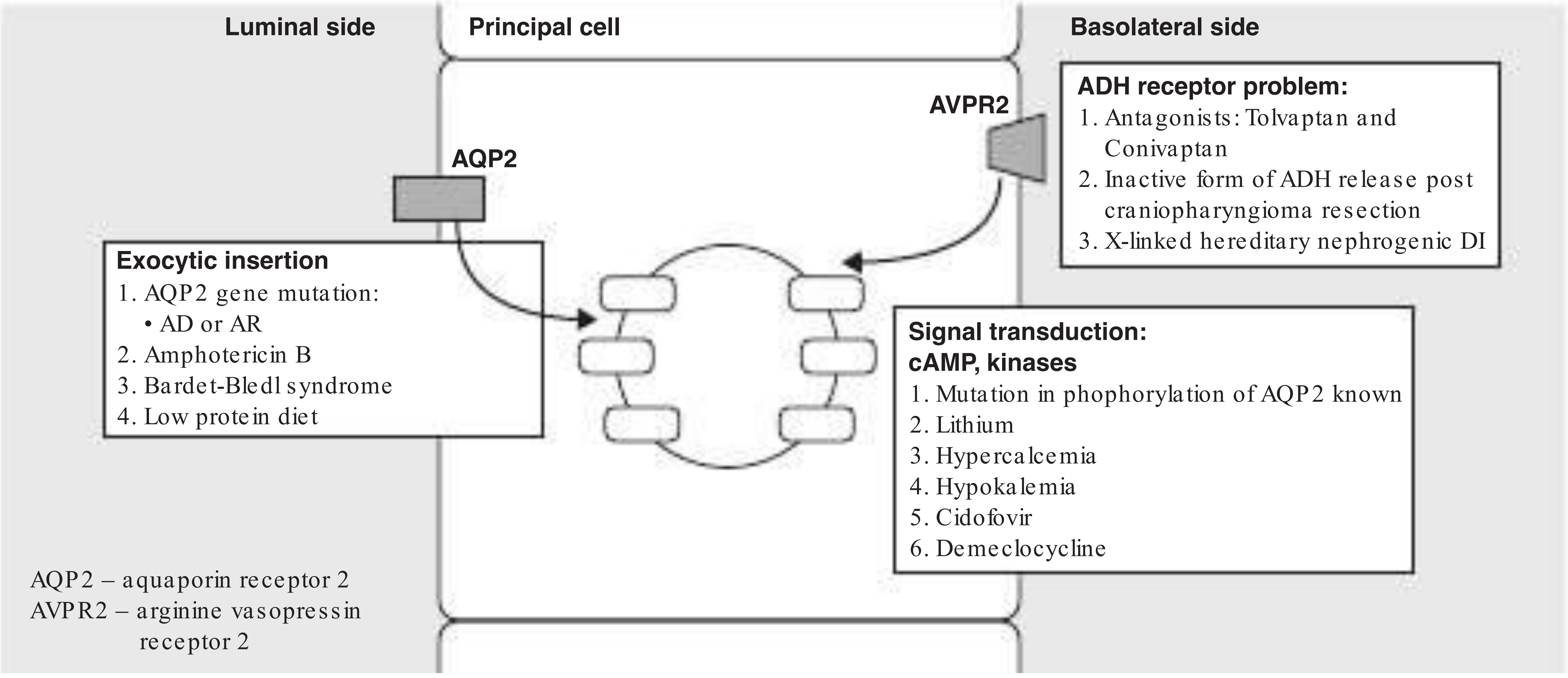

Luminal side
Principal cell
Basolateral side
AVPR2
AQP2
ADH receptor problem:
1. Antagonists: Tolvaptan and Conivaptan
2. Inactive form of ADH release post craniopharyngioma resection
3. X-linked hereditary nephrogenic DI
Exocytic insertion
1. AQP2 gene mutation:
• AD or AR
2. Amphotericin B
3. Bardet-Bledl syndrome
4. Low protein diet
Signal transduction: cAMP, kinases
1. Mutation in phophorylation of AQP2 known
2. Lithium
3. Hypercalcemia
4. Hypokalemia
5. Cidofovir
6. Demeclocycline
AQP2 – aquaporin receptor 2
AVPR2 – arginine vasopressin receptor 2

Figure 12.25. Causes of nephrogenic DI.

- ADH release is stimulated by changes in blood osmolality sensed by the hypothalamic osmoreceptors.
- ADHR (ADH receptor) stimulation leads to signal transduction process in which aquaporins (water channels) are released from intracellular vesicles into the luminal membrane so that water can enter the cell and then blood vessels.

HYPERCALCEMIA

MCC OBJECTIVE

Based on Objective #12-2 (Calcium Disorders) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Definition

- The presence of a high serum calcium level in the blood

APPLIED SCIENTIFIC CONCEPTS

- Calcium exists in the blood as free ionized calcium (40%) and protein-bound calcium (60%). Only the free ionized calcium is metabolically active.
- Serum calcium levels are regulated by both PTH and vitamin D.
  - PTH is secreted in response to low calcium levels and acts on the bone (to increase resorption) and the kidney (to increase calcium reabsorption and increase vitamin D [calcitriol] production). PTH is responsive to very small changes in serum calcium levels.
  - Vitamin D is produced in response to PTH and low serum calcium levels. It increases intestinal calcium absorption.

Serum calcium levels can fluctuate with changes in serum albumin levels and blood pH. Low albumin levels lead to low calcium levels. Acidosis reduces protein binding of calcium. Free ionized calcium levels usually remain constant in these conditions, so it is advisable to directly measure ionized calcium levels in conditions of hypoalbuminemia, acidosis, or alkalosis. One can also correct for hypoalbuminemia, as serum calcium levels fall roughly 0.2 mmol/L for every 10 g/L drop in albumin.

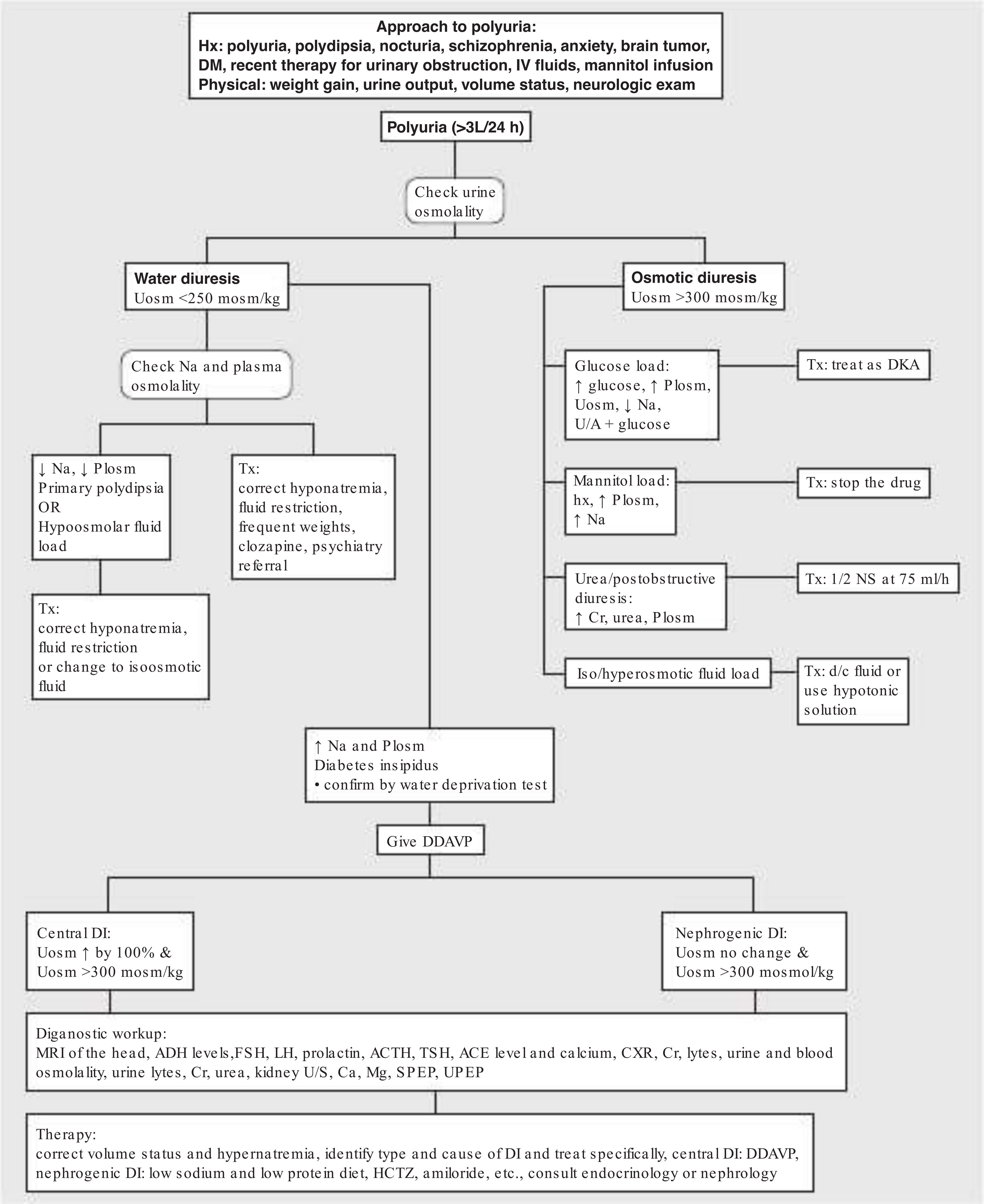

Approach to polyuria:
Hx: polyuria, polydipsia, nocturia, schizophrenia, anxiety, brain tumor, DM, recent therapy for urinary obstruction, IV fluids, mannitol infusion
Physical: weight gain, urine output, volume status, neurologic exam
Polyuria (>3L/24 h)
Check urine osmolality
Water diuresis
Uosm <250 mosm/kg
Osmotic diuresis
Uosm >300 mosm/kg
Check Na and plasma osmolality
↓ Na, ↓ Plosm
Primary polydipsia
OR
Hypoosmolar fluid load
Tx:
correct hyponatremia, fluid restriction, frequent weights, clozapine, psychiatry referral
Tx:
correct hyponatremia, fluid restriction or change to isoosmotic fluid
Glucose load:
↑ glucose, ↑ Plosm, Uosm, ↓ Na, U/A + glucose
Tx: treat as DKA
Mannitol load:
hx, ↑ Plosm, ↑ Na
Tx: stop the drug
Urea/postobstructive diuresis:
↑ Cr, urea, Plosm
Tx: 1/2 NS at 75 ml/h
Iso/hyperosmotic fluid load
Tx: d/c fluid or use hypotonic solution
↑ Na and Plosm
Diabetes insipidus
• confirm by water deprivation test
Give DDAVP
Central DI:
Uosm ↑ by 100% &
Uosm >300 mosm/kg
Nephrogenic DI:
Uosm no change &
Uosm >300 mosmol/kg
Diganostic workup:
MRI of the head, ADH levels,FSH, LH, prolactin, ACTH, TSH, ACE level and calcium, CXR, Cr, lytes, urine and blood osmolality, urine lytes, Cr, urea, kidney U/S, Ca, Mg, SPEP, UPEP
Therapy:
correct volume status and hypernatremia, identify type and cause of DI and treat specifically, central DI: DDAVP, nephrogenic DI: low sodium and low protein diet, HCTZ, amiloride, etc., consult endocrinology or nephrology

Figure 12.26. Approach to polyuria.

CAUSAL CONDITIONS

- Increased bone resorption
  - 1° hyperparathyroidism
  - 2° or tertiary hyperparathyroidism
    - Chronic kidney disease
  - Malignancy
    - Metastasis to bone with induction of local osteolysis
    - Release of osteoclast-activating factors (multiple myeloma)
    - Secretion of PTH-related peptide (PTHrP)
  - Hyperthyroidism
  - Immobilization
- Increased calcium absorption
  - Increased calcium intake
    - Dietary supplements
    - Milk-alkali syndrome
  - Increased vitamin D
    - Increased intake of vitamin D supplements
    - Endogenous increase in vitamin D
      - Lymphoma
      - Granulomatous disease (e.g., sarcoidosis)
- Decreased excretion
  - Thiazide diuretics
  - Familial hypocalciuric hypercalcemia

APPROACH

Always ensure that hypercalcemia is true (check ionized calcium levels or correct for albumin) (Figure 12.27)

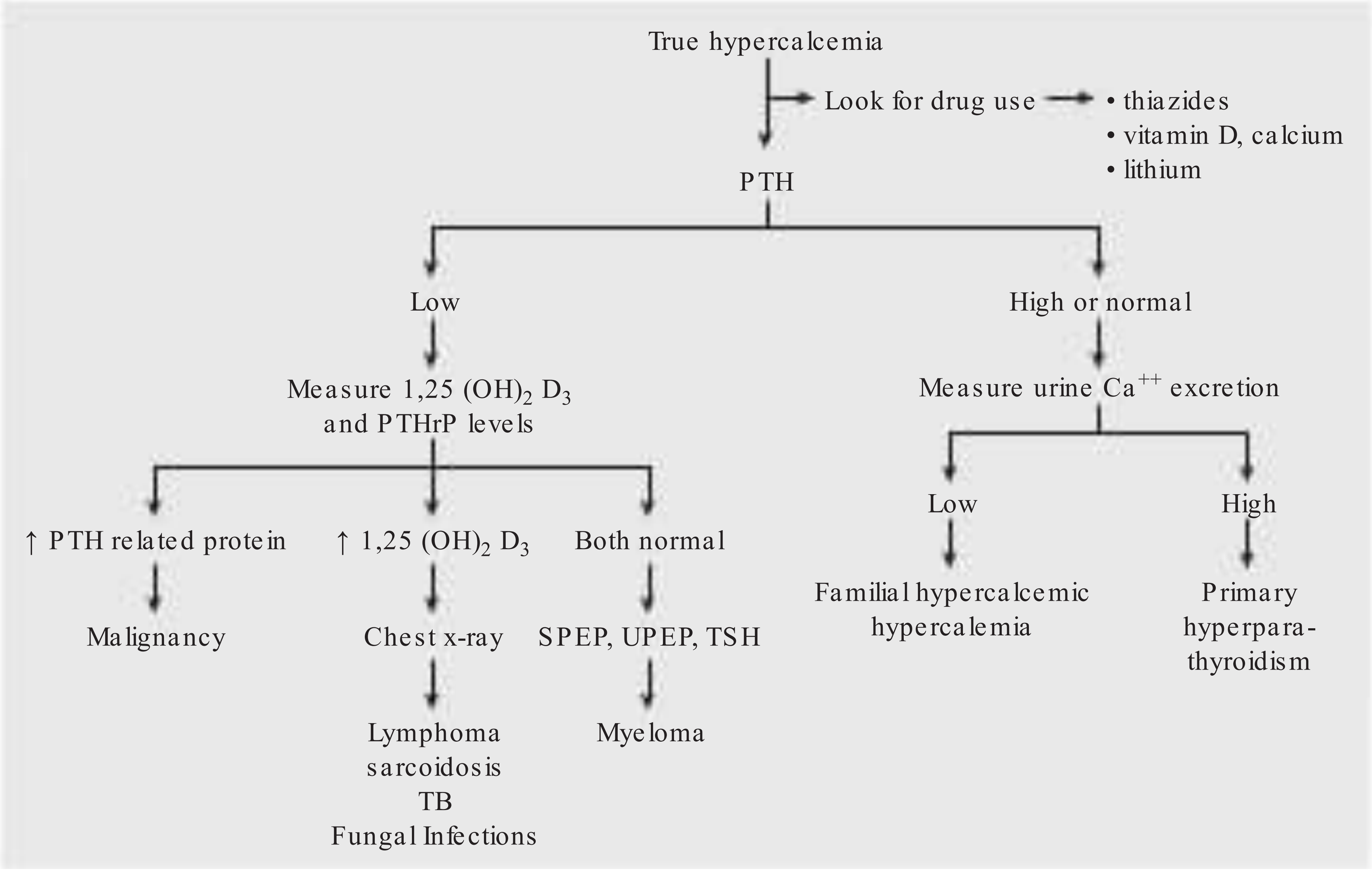


Figure 12.27. Approach to hypercalcemia.

Management

- Step 1—is the patient markedly symptomatic and calcium > 3.5 mmol/L?
  - Neurologic (confusion, stupor, coma)
  - Renal (acute renal failure)
  - Musculoskeletal (profound weakness)
    - If no, urgent treatment not required (see Step 3)
    - If yes, urgent treatment required (see Step 2)

- Step 2A—start IV rehydration, calcitonin, and bisphosphonate therapy
  - IV normal saline 200 to 300 mL/h adjusted to achieve urine output of 100 to 150 mL/h
    - Use caution if coexisting heart or renal failure
  - Calcitonin 4 IU/kg IM or SC every 12 h × 48 h
  - Pamidronate 60 to 90 mg IV
    - Use caution if coexisting renal impairment
  - Hemodialysis may be required for severe hypercalcemia in the setting of renal failure
- Step 2B—is vitamin D excess the cause?
  - If yes, start prednisone 20 to 40 mg/d
- Step 3—avoid drugs that can aggravate hypercalcemia (thiazides, calcium supplements, vitamin D) and treat underlying cause (hyperparathyroidism, granulomatous disease, etc.)

HYPOCALCEMIA

MCC OBJECTIVE

Based on Objective #12-2 (Calcium Disorders) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Definition

- The presence of a low serum calcium level in the blood

APPLIED SCIENTIFIC CONCEPTS

- Calcium exists in the blood as free ionized calcium (40%) and protein-bound calcium (60%). Only the free ionized calcium is metabolically active.
- Serum calcium levels are regulated by both PTH and vitamin D.
  - PTH is secreted in response to low calcium levels and acts on the bone (to increase resorption) and the kidney (to increase calcium reabsorption and increase vitamin D [calcitriol] production). PTH is responsive to very small changes in serum calcium levels.
  - Vitamin D is produced in response to PTH and low serum calcium levels. It increases intestinal calcium absorption.

Serum calcium levels can fluctuate with changes in serum albumin levels and blood pH. Low albumin levels lead to low calcium levels. Acidosis reduces protein binding of calcium. Free ionized calcium levels usually remain constant in these conditions, so it is advisable to directly measure ionized calcium levels in conditions of hypoalbuminemia, acidosis, or alkalosis. One can also correct for hypoalbuminemia, as serum calcium levels fall roughly 0.2 mmol/L for every 10 g/L drop in albumin.

CAUSAL CONDITIONS

- Pseudohypocalcemia
  - Low serum calcium but normal ionized calcium levels (e.g., hypoalbuminemia)
- Spuriouas hypocalcemia
  - Low serum calcium following injection of gadolinium-based contrast agents
- True hypocalcemia
  - Excessive loss
    - Extravascular deposition (hyperphosphatemia, rhabdomyolysis, pancreatitis, posttransfusion)
    - Renal losses (loop diuretics)
  - Decreased absorption
    - Vitamin D deficiency
      - Decreased intake or absorption (GI surgery, pancreatitis, small bowel disease)
      - Decreased 1α-hydroxylation (renal failure, type 1 rickets)
      - Decreased 25α-hydroxylation (liver failure)

    - Vitamin D resistance
      - Type 2 rickets
  - Reduced PTH production
    - 1° hypoparathyroidism (postsurgical, autoimmune, DiGeorge syndrome)
    - Altered calcium sensor activity (autosomal dominant hypocalcemia)
    - Hypomagnesemia (malabsorption, alcoholism, cisplatin)
  - PTH Resistance
    - Pseudohypoparathyroidism
    - Hypomagnesemia
  - Drugs
    - Chelators
    - Bisphosphonates
    - Cinacalcet
    - Foscarnet

AppRoAch

Always ensure that hypocalcemia is true (check ionized calcium levels or correct for albumin) (Figure 12.28)

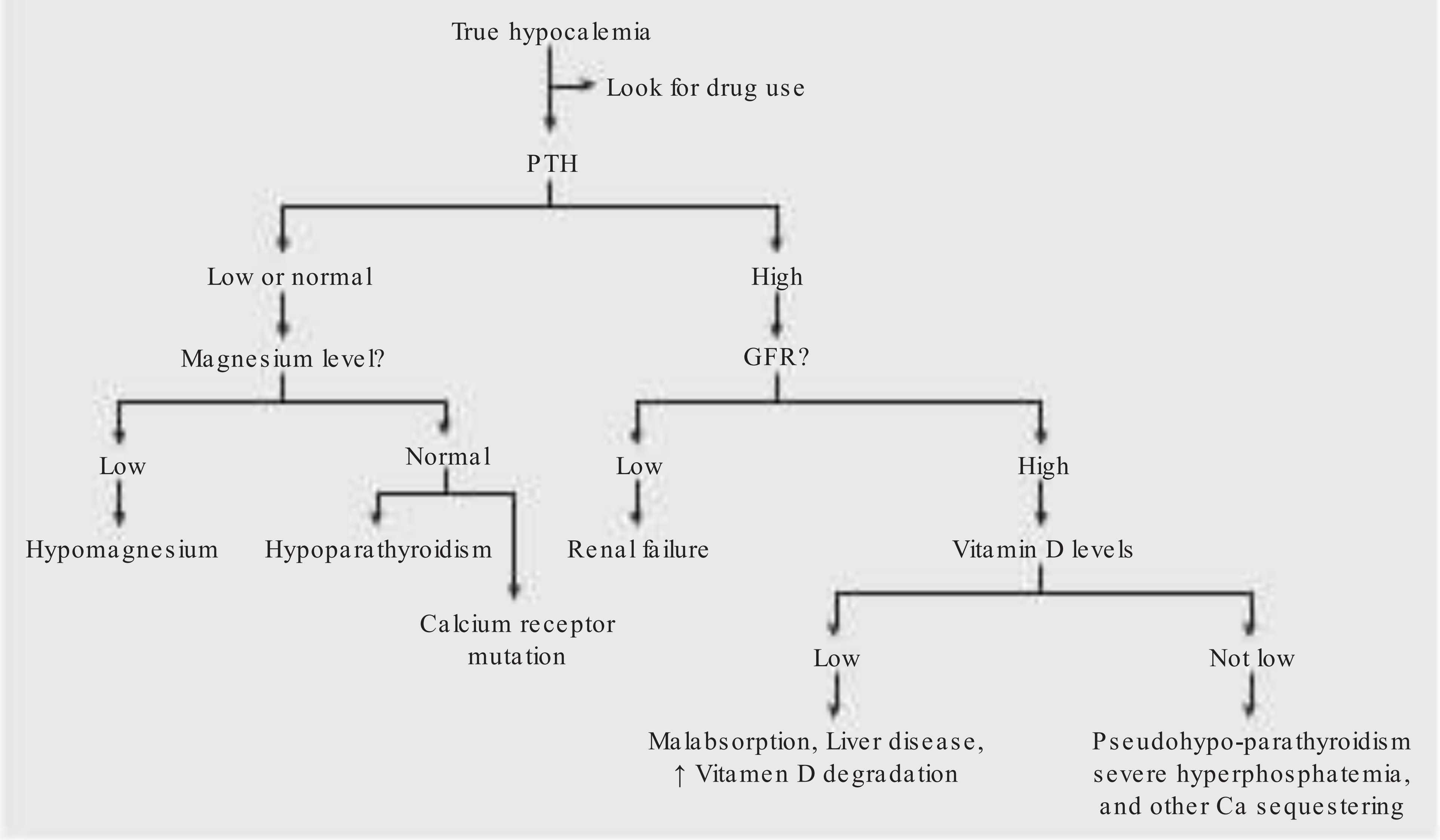


Figure 12.28. Approach to hypocalcemia.

Management

- Step 1—is the patient symptomatic and calcium < 1.9 mmol/L?
  - Paresthesias, carpopedal spasm, tetany, seizures
  - Trousseau or Chvostek sign, bradycardia
  - Prolonged QT interval on EKG
    - If yes, give IV calcium gluconate 1 to 2 g IV over 10 to 20 min
    - If no, start oral calcium carbonate 1500 to 2000 mg elemental calcium daily
- Step 2—is patient also hypomagnesemic?
  - If yes, start Mg^{2+} replacement
- Step 3—is patient also vitamin D deficient or hypoparathyroid?
  - If yes, start vitamin D replacement 1000 units daily
  - Use calcitriol 0.25 μg daily if renal failure
  - Reduce dose or add thiazide diuretic if hypercalciuria develops

HYPERPHOSPHATEMIA

CLINICAL box

Normal Plasma Phosphate

- 1.0 to 1.5 mmol/L

MCC OBJECTIVE

Based on Objective #12-2 (Calcium Disorders) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Most abundant intracellular anion.
- 85% of total body phosphorus is in bone and teeth.
- 1% is present in extracellular fluid.
- Phosphorus is vital for metabolic processes such as formation of high energy ATP and a component of cell membranes.

CLINICAL box

Pseudohyperphosphatemia may occur with interference of assay by immunoglobulins, bilirubin, hemolysis, hyperlipidemia, liposomal amphotericin B.

APPLIED SCIENTIFIC CONCEPTS

- 65% of dietary phosphate is absorbed from the gut.
- Phosphate absorption is reduced by complexing with polyvalent cations such as Ca^{2+}, Mg^{2+}, and Al^{3+} in the diet.
- Excess phosphate absorbed in the diet is excreted by the kidneys, which are the 1° regulators of phosphate balance.
- Plasma phosphate is regulated by:
  - Humoral factors which regulate renal phosphate excretion and GI phosphate absorption
    - PTH
    - Phosphatonins (e.g., FGF-23)
  - Local factors, for example, insulin
- For physiologic response to hyperphosphatemia, see Figure 12.29.

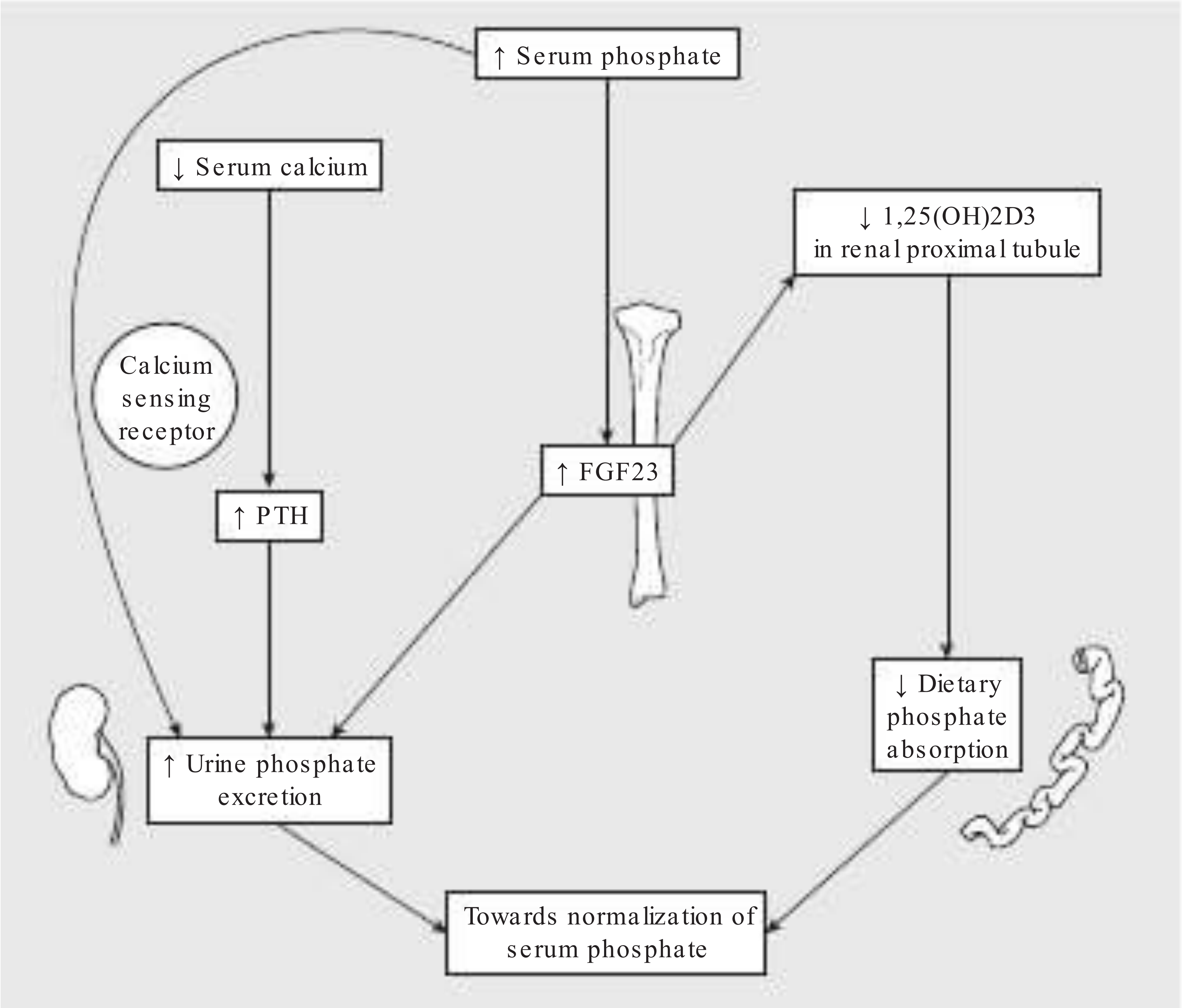


Figure 12.29. Physiologic response to hyperphosphatemia.

CAUSAL CONDITIONS

- Acute high phosphate load
  - Cell lysis: rhabdomyolysis, tumor lysis syndrome, massive hemolysis
  - Translocation of intracellular phosphate to extracellular fluid: lactic acidosis, ketoacidosis
  - Exogenous load: use of phosphate-containing laxatives, especially in setting of reduced renal function, intravenous phosphate infusion
- Renal failure: reduced filtration and excretion
- Increased GI absorption: excess vitamin D
- Increased renal phosphate reabsorption
  - Hypoparathyroidism
  - Acromegaly
  - Medications: bisphosphonates, excess vitamin D
  - Familial tumoral calcinosis

APPROACH

History

- Hematologic malignancy, trauma, muscle injury, transfusion reaction, phosphate enema laxative use, renal failure, vitamin D intake, family Hx

Physical Exam

- Features of acromegaly, chronic renal failure, trauma, compartment syndrome, sepsis, causes of acidosis

Investigation

- Exclude hemolysis (bilirubin, LDH, haptoglobin, peripheral smear); rhabdomyolysis (CK, myoglobinuria); tumor lysis (uric acid) especially if also hyperkalemia; lactate, ketones PTH, creatinine, BUN, calcium

Management

- Acute hyperphosphatemia should resolve within hours if renal function is intact and cause is removed.
- Volume expansion and hydration may enhance phosphate excretion; attention must be paid to avoid exacerbation of hypocalcemia.
- Hemodialysis may be required if accompanied by severe hypocalcemia and renal dysfunction.
- Chronic hyperphosphatemia is managed by low-phosphate diet and binding of dietary intestinal phosphate (e.g., calcium, sevelamer, lanthanum, dialysis).

CLINICAL box

Hyperphosphatemia of Chronic Kidney Disease

- Hyperphosphatemia is common with a reduced GFR and worsens as GFR declines.
- Dietary phosphate restriction and administration of phosphate binders are important to control hyperphosphatemia. Sevelamer cannot be used in pre-ESRD.
- Phosphate binders must be taken with meals to be effective.
- Uncontrolled hyperphosphatemia leads to 2° hyperparathyroidism, renal osteodystrophy, and tissue calcium/phosphate deposition, and is a risk factor for death.
- Dialysis alone is usually insufficient to control hyperphosphatemia of ESRD, and use of binders and diet is important.

HYPOPHOSPHATEMIA

MCC OBJECTIVE

Based on Objective #12-2 (Calcium Disorders) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Most abundant intracellular anion.
- 85% of total body phosphorus is in bone and teeth.
- 1% is present in extracellular fluid.
- Phosphorus is vital for metabolic processes such as formation of high energy ATP and a component of cell membranes.

APPLIED SCIENTIFIC CONCEPTS

- 65% of dietary phosphate is absorbed from the gut.
- Phosphate absorption is reduced by complexing with polyvalent cations such as Ca^{2+}, Mg^{2+}, and Al^{3+} in the diet.
- Excess phosphate absorbed in the diet is excreted by the kidneys, which are the 1° regulators of phosphate balance.

- Plasma phosphate is regulated by:
  - Humoral factors which regulate renal phosphate excretion and GI phosphate absorption
    - PTH
    - Phosphatonins (e.g., FGF-23)
  - Local factors, for example, insulin

CLINICAL box

Normal Plasma Phosphate

- 1.0 to 1.5 mmol/L

CLINICAL box

Spurious hypophosphatemia may occur with paraproteinemia and interference with assay.

CAUSAL CONDITIONS

- Phosphate redistribution
  - Refeeding syndrome, DKA, insulin secretion
  - Hungry bone syndrome, for example, postparathyroidectomy
  - Hyperventilation with acute respiratory alkalosis
- Reduced absorption from GI tract
  - Poor oral intake
  - Phosphate binding in GI tract by antacid medications Al^{3+}, Mg^{2+}, or Ca^{2+}
  - Chronic diarrhea with malabsorption
- Increased renal excretion
  - Hyperparathyroidism
  - Vitamin D deficiency
  - Fanconi syndrome
  - Oncogenic osteomalacia
  - Hereditary hypophosphatemic rickets
  - Diuresis: osmotic, hypervolemia

APPROACH (Figure 12.30)

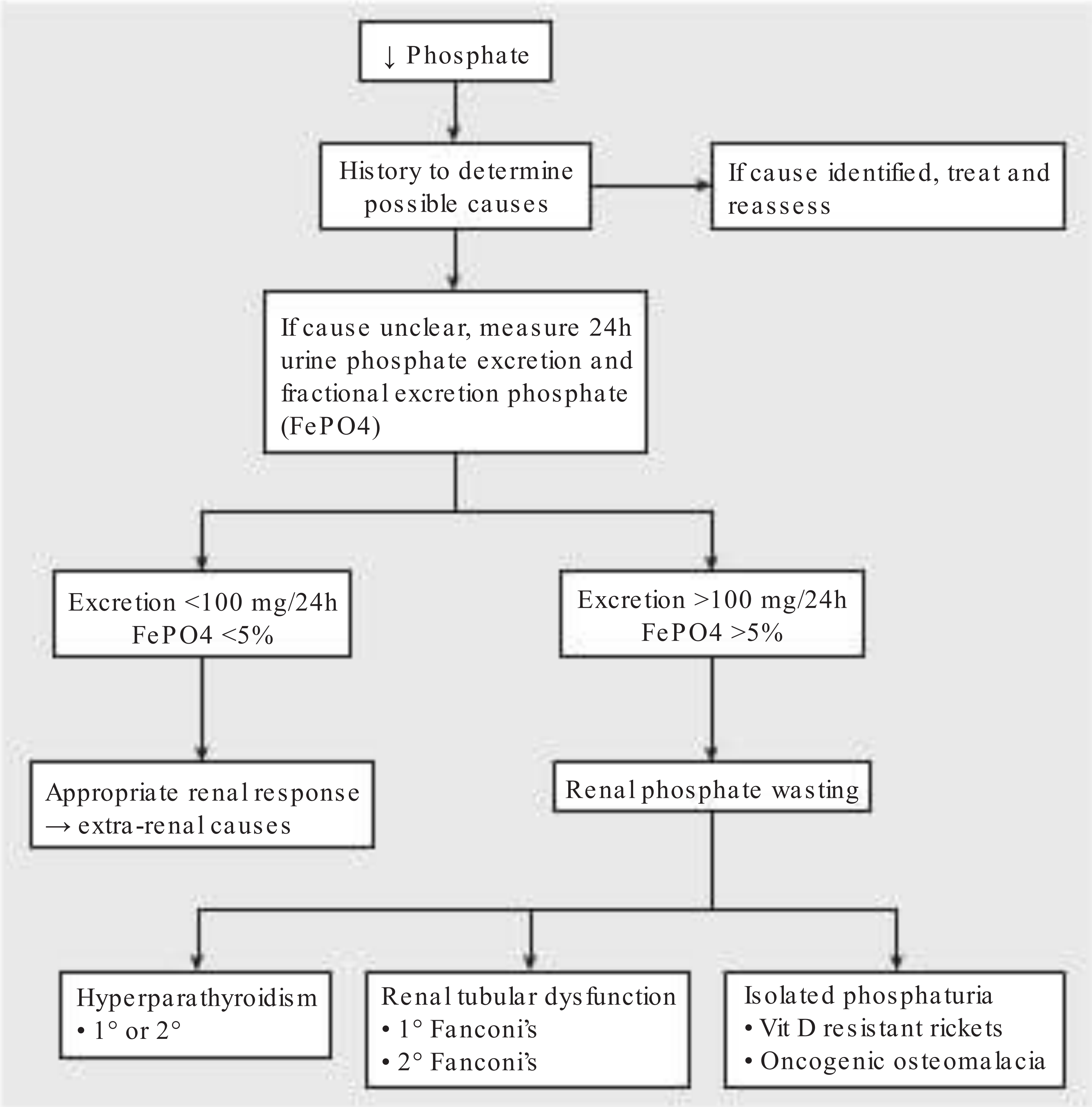

↓ Phosphate
History to determine possible causes
If cause identified, treat and reassess
If cause unclear, measure 24h urine phosphate excretion and fractional excretion phosphate (FePO4)
Excretion <100 mg/24h FePO4 <5%
Excretion >100 mg/24h FePO4 >5%
Appropriate renal response → extra-renal causes
Renal phosphate wasting
Hyperparathyroidism • 1° or 2°
Renal tubular dysfunction • 1° Fanconi's • 2° Fanconi's
Isolated phosphaturia • Vit D resistant rickets • Oncogenic osteomalacia

Figure 12.30. Approach to hypophosphatemia.

History

- Look for causal conditions, dietary Hx of malabsorption, use of antacids, alcoholism, malnutrition, refeeding, family Hx

Physical Exam

- Signs of nutrition, rickets, encephalopathy, seizures, heart failure, hypoventilation, proximal myopathy, ileus, rhabdomyolysis

Management

- If possible, identify a reversible cause and treat, for example, manage diarrhea, stop antacid use, replete vitamin D
- If phosphate < 0.64 mmol/L and patient asymptomatic, replete with oral phosphate 30 to 80 mmol/d, high-phosphate diet
- If phosphate < 0.32 mmol/L and patient symptomatic or cannot take oral phosphate, replete with IV phosphate until level > 0.48 mmol/L then switch to oral supplementation
    - If phosphate ≥ 0.4 mmol/L, give 0.08 to 0.24 mmol/kg over 6 h
    - If phosphate < 0.4 mmol/L, give 0.5 to 0.25 mmol/kg over 6 h
- Replace at half dose in patients with renal dysfunction
- Choose potassium or sodium phosphate preparations depending on other needs or renal function (avoid potassium phosphate with renal dysfunction)
- Monitor serum phosphate six hourly and adjust supplementation; stop repletion once phosphate > 0.64 mmol/L
- Risk of rapid infusion of phosphate includes calcium-phosphate precipitation, AKI, and arrhythmias
- If the 1° problem is urinary potassium wasting, dipyridamole may be effective

CLINICAL box

Clinical consequences of hypophosphatemia result from:

- Altered bone and mineral metabolism
- Reduced production of cellular ATP

Symptoms generally begin to occur when phosphate < 0.64 mmol/Land may be severe with PO_4^{3-} < 0.32 mmol/L

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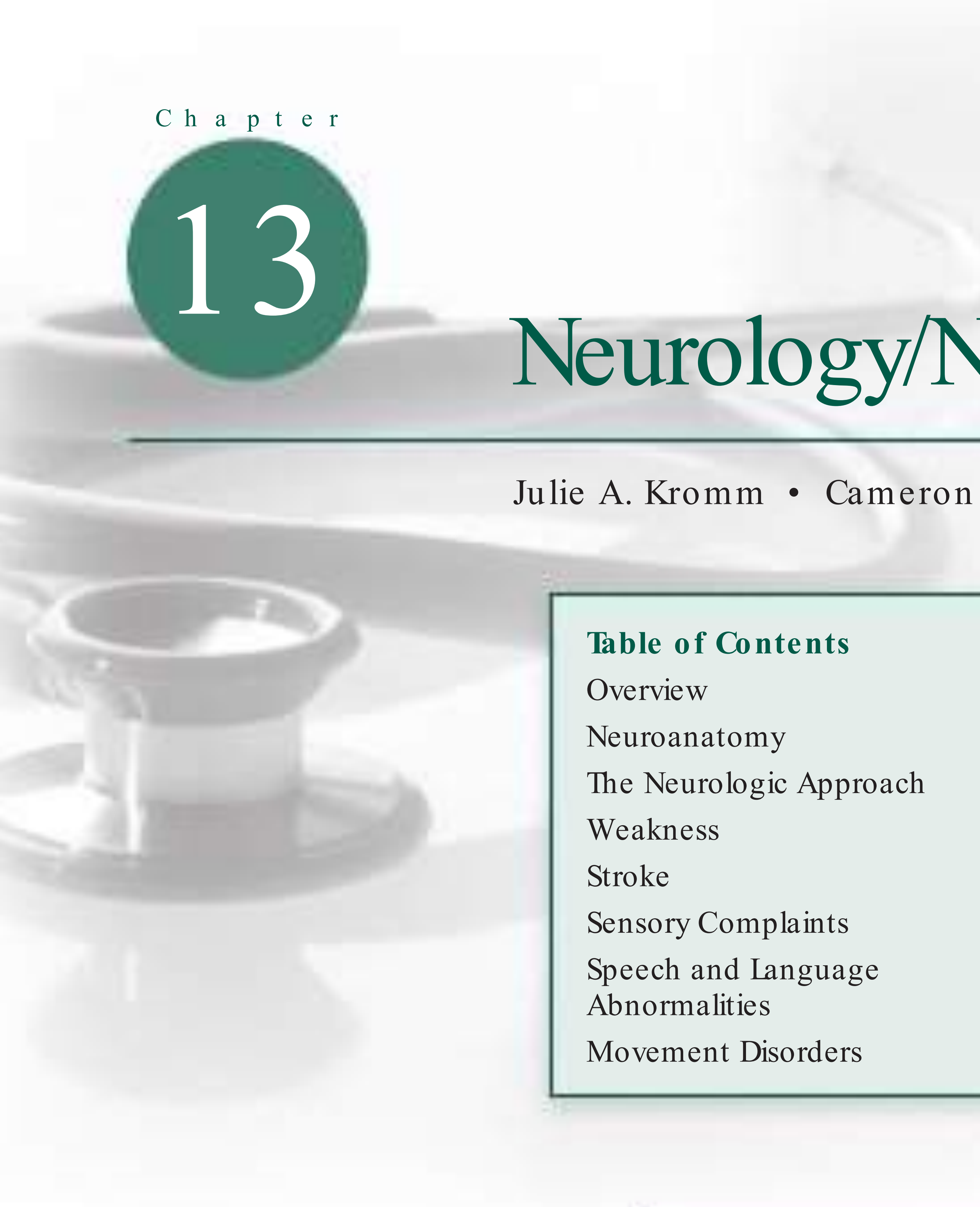

Chapter

13

Neurology/Neurosurgery

Julie A. Kromm • Cameron A. Elliott • Michael Edward Knash

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OVERVIEW

Neurology is notoriously daunting for most. In fact the term *neurophobia* was coined in 1994 by Józefowicz as the fear of the neural sciences and clinical neurology due to the students' inability to apply their knowledge of basic sciences to clinical situations. This is a common condition experienced by almost half of medical students and a substantial amount of practicing physicians, which results in anxiety, avoidance, dislike, and eventually disinterest in neurology. When the pressure of exam preparation is added to this aversion, the subject becomes even less appealing. Fear not! When basic principles are applied, the approach to neurology is easily simplified, as we will demonstrate throughout this chapter.

Anatomical and functional knowledge of the nervous system is fundamental for practicing neurology; however, for most clinicians, only a basic understanding is necessary—leave learning the minutia to the neurologists and neurosurgeons.

The key neuroanatomical structures to pay particular attention to include:

- Surface anatomy of the brain—lobes, major sulci, fissures, and gyri
- Surface anatomy of the brainstem—the intricate internal structures of the brainstem need not be learned at this level of your training, but knowledge of which level of the brainstem (midbrain, pons, medulla) the cranial nerves originate from is key.
- Corticospinal/corticobulbar tracts (voluntary movement)
- Spinothalamic tract (pain and temperature)
- Dorsal columns (proprioception and vibration)

Prior to exploring the common neurologic presentations that frequently occur in clinical medicine and LMCC exams, we will first review basic relevant neuroanatomy and a straightforward approach to the assessment of any neurologic complaint. The remainder of the chapter is organized into common topics emphasizing the outlined approach to lesion localization and particular LMCC objectives.

NEUROANATOMY (Figure 13.1)

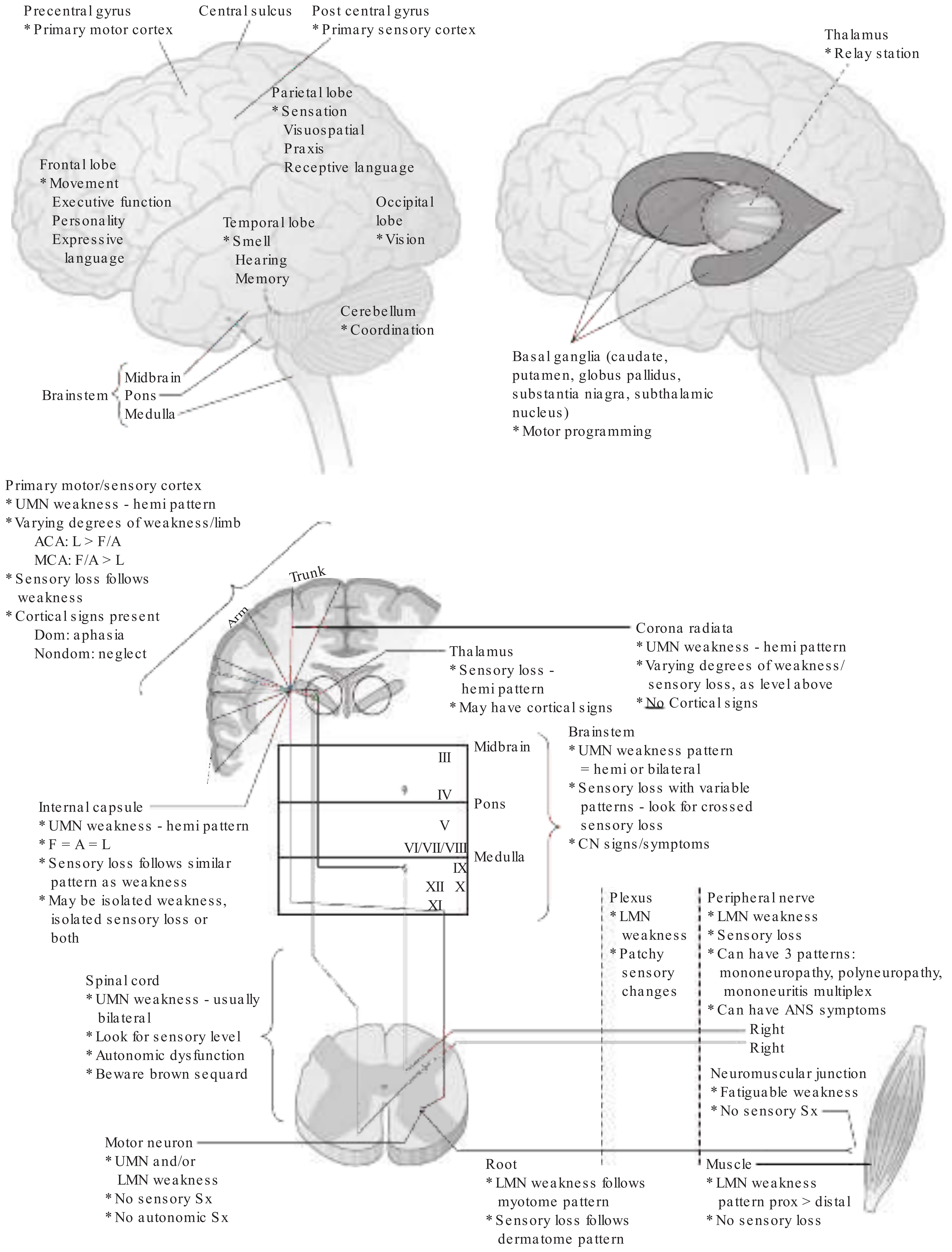


Figure 13.1. Basic neuroanatomy.

THE NEUROLOGIC APPROACH

Neurology is no different from all other areas of medicine. The approach is simple. Obtain a thorough Hx and physical exam, localize the problem, establish a DDx, investigate accordingly, solidify the Dx, and treat appropriately.

Students tend to get caught up at the localization point of the algorithm. But, this step is no different from other specialties in medicine, with the exception that in neurology our localizations may be a bit more precise. For example, an internist might see a patient with dyspnea and may localize the problem to the lungs or heart, whereas a neurologist might see a patient with weakness and localize the issue to muscle, the neuromuscular junction, nerves, spinal cord, brainstem, or brain. In both situations, the physician localizes the lesion based on his or her recognition of patterns and knowledge of anatomy/physiology.

In the steps that follow, we will walk you through how a neurologist/neurosurgeon thinks every time he or she sees a patient.

STEP #1

- Ensure the patient is stable and address life-threatening conditions

STEP #2

History

- **ID:** age, gender, hand dominance (hemispheric language dominance and understand disability/impact of Sx)
- CC:
- **HPI:** Characterization of Sx:
  - Onset—acute, subacute, insidious (exact time important in stroke)
  - Precipitating factors—infection, trauma, toxins, etc.
  - Course of Sx—stable, improving, worsening, episodic
  - Aggravating/alleviating factors
  - Severity/functional inquiry—ADLs and IADLs
  - Associated Sx:
    - General—loss of consciousness, headache, seizures (antecedent events, ictus, postictal)
    - Cognition—memory, language, visuospatial, recognition, praxis, etc.
    - Autonomic—bowel/bladder changes, sexual dysfunction, change in sweating pattern, etc.
    - Cranial nerves—anosmia, visual Sx, diplopia, facial numbness/pain, facial droop, vertigo, hearing loss, dysphagia, dysarthria, etc.
    - Motor—muscle atrophy, cramps
      - Weakness
        - Proximal (getting out of chair, combing hair, reaching up)
        - Distal (tripping, dropping things, decreased dexterity hands)
          - Symmetric/asymmetric, fatigable
          - Ascending/descending pattern
      - Involuntary movements
        - Hypokinetic (bradykinesia/akinesia)
        - Hyperkinetic (chorea, ballismus, dystonia, tics, myoclonus)
      - Tremors—intention/kinetic, rest, postural
  - Sensory—anesthesia, paresthesia, dysesthesia, pain
  - Cerebellar—incoordination, falls
- **ROS:** infectious Sx, constitutional Sx, HEENT, CVS, Resp, GI, GU, MSK, integument
- PMHx:
  - HTN, dyslipidemia, DM, CVA/TIA, CAD, mechanical heart valves, AFib
  - Bleeding/clotting disorders
  - Neoplasms, Sz, migraines
  - Other—cardiac, Resp, GI, GU, MSK, etc.
- PSHx:
  - Neurosurgical procedure, back surgery, etc.
  - Other surgeries

CLINICAL box

ADLs and IADLs

ADLs
- Dressing
- Eating
- Ambulating
- Toileting
- Hygiene

Instrumental ADLs
- Shopping
- Housekeeping
- Accounting
- Food preparation
- Taking medications
- Telephone usage
- Transportation

- **Psych Hx: Baseline (i.e. pre-illness) personality/temperament, prior psychiatric admissions/diagnoses, psych sx (psychosis, mood disorder, anxiety), suicidal ideations**
- **Pobs/gyne Hx:** recurrent miscarriages (antiphospholipid antibody syndrome), sexual Hx (tertiary syphilis)
- **Meds:** all prescribed and OTC medications including herbals and supplements.
- **Allergies**
- **FHx**
- **SHx:** relationship status, children, education, occupation (hazardous exposures), hobbies/pets, EtOH, smoking, drugs, travel (Lyme disease, exotic infections), etc.

CLINICAL box

A patient's LOC, orientation, and language should always be briefly assessed even prior to taking a Hx, as this guide you in knowing how reliable the patient is and how the clinical situation should be approached.

STEP #3

Physical Exam

The neurologic exam is one of the most complex physical exams in medicine. An organized approach will help ensure comprehensiveness.

- Wash your hands!! (You get marks for that on OSCEs)
- Vitals
- Overall inspection
- Level of consciousness
  - Always describe exactly what you see. GCS is also helpful.
  - Alert
  - Confused
  - Delirious
  - Lethargic—mild decrease in consciousness, easily aroused (easily awakened by voice, answers questions, then falls back asleep)
  - Obtunded—cannot be fully aroused (awakens to light shaking, slow to answer questions, confused, decreased alertness, decreased awareness of environment)
  - Stuporous—sleep-like state (awakens to pain, slow/absent responses, minimal alertness and awareness of environment, falls back asleep when pain removed)
  - Comatose—unrousable unresponsiveness

CLINICAL box

Glasgow Coma Scale

Eyes	Voice	Motor
4—spontaneously open	5—normal	6—follows commands
3—open to voice	4—confused	5—localizes pain
2—open to pain	3—inappropriate words	4—withdraws to pain
1—no do not open	2—incomprehensible sounds	3—flexor posturing
	1—no response	2—extensor posturing
		1—no movement

Mental Status

- At the very least, assess orientation to place and time. May also assess language, memory, and visuospatial function with MMSE/MOCA.

Language Exam

- Fluency—describe a picture or what they had for breakfast
- Naming—name both high-frequency/common (watch, pen) and low-frequency objects (strap of watch, hands or face of watch, nib of pen)
- Repetition—repetition of simple (hello), moderate (I am here), and complex (no ifs ands or buts) phrases
- Comprehension—perform simple (point to ceiling), moderate (point to ceiling and shut eyes), and complex (point to ceiling and shut eyes after opening mouth) tasks
- Reading
- Writing

Cranial Nerve Exam

- **CN I—olfactory nerve**
  - **Sensation**—rarely tested
    - Check that nasal passages are clear → with patients eyes closed plug one nostril and ask patient to smell stimulus (do not use noxious stimuli) → ask patient to ID scent (repeat on other nostril)
- **CN II—optic nerve**
  - **Sensation**
    - **Visual acuity—**best corrected vision (i.e., glasses worn), tested one eye at a time. Use Snellen eye chart/near eye chart (must get minimum of ½ letters right on line). If unable to read largest letter of Snellen chart proceed as follows: decrease distance to ≥3 in → finger counting (note distance) → see hand motion (note distance) → light perception
    - **Visual fields—**confrontational testing (numbers or hand movements)
      - Map blind spot
      - Test for neglect (by providing stimuli to both sides simultaneously)
  - **Reflex**
    - **Pupillary light reflex—**afferent = CN II; efferent = CN III
      - Assess direct and consensual responses
      - Swinging flash light test to assess for RAPD
  - **Inspection**
    - **Ophthalmoscopy**
      - Assess retina, vessels, disc border, disc color, cup-to-disc ratio
      - Ensure there are no retinal hemorrhages or papilledema
- **CN III—oculomotor nerve**—controls superior rectus (elevates), inferior rectus (depresses), medial rectus (adducts), inferior oblique (elevates adducted eye, extorts abducted eye), levator palpebrae superioris (raises eyelid; lesion causes ptosis), as well as parasympathetic innervation to pupillary sphincter (constricts pupil) and ciliary muscles (accommodation)
- **CN IV—trochlear nerve**—controls superior oblique muscle (depression of adducted eye, intorsion [inward rotation] of abducted eye)

CLINICAL box

CN VII lesions:
UMN—forehead spared
LMN—forehead involved

- **CN V—trigeminal nerve**
  - **Sensation**: pain, temperature, and light touch of ophthalmic, maxillary, and mandibular regions
  - **Motor**: strength of masseter and temporalis (palpate while patient clenches teeth), pterygoids
  - **Reflexes:**
    - Corneal reflex—afferent = CN V; efferent = CN VII
    - Touch patients' cornea with tissue (avoid threat), a watch for bilateral clenching of eyes closed
    - Jaw jerk reflex—afferent = CN V; efferent = CN V
- **CN VI—abducens nerve**—controls lateral rectus muscle (abducts the eye)
  - **Motor assessment:**
    - **EOM—**six cardinal directions of gaze
    - **Convergence—**have patient look at nose
    - **Nystagmus—**assess for at extremes of gaze
    - **Saccades—**have patient look at nose and then quickly at outstretched finger. Look for over/undershooting (i.e., hypermetric/hypometric saccades)
- **CN VII—facial nerve**
  - **Motor**: inspect for symmetry as patient raises eye brows, frowns, tightly closes eyes, shows upper and lower teeth, smiles, puffs out cheeks, etc.
    - Ask about hyperacusis (nerve to the stapedius muscle)
  - **Special sensory:** taste to the anterior of the tongue
- **CN VIII—vestibulocochlear nerve**
  - **Sensation** (use 512 Hz tuning fork)
    - Screening
      - Whisper test
      - Weber test—lateralization (louder—conductive, quieter—sensorineural)
        - Rinne test—assess air conduction (AC) vs. bone conduction (BC)
        - AC > BC—normal or sensorineural hearing loss
        - BC > AC—conductive hearing loss
- **CN IX—glossopharyngeal nerve**
  - **Motor**: assess palatal elevation (symmetry)

  - **Reflex**: gag reflex—afferent = CN IX; efferent = CN X
  - **Special sensory**: taste—posterior third of tongue
- **CN X—vagus nerve**
  - **Motor**: voice quality and gag
- **CN XI—spinal accessory nerve**
  - **Motor**: assess for atrophy, fasciculations, and strength of SCM and trapezius.
- **CN XII—hypoglossal nerve**
  - **Motor**: tongue atrophy, fasciculations, symmetry on protrusion, strength

CLINICAL box

CN IX Lesions

The palate deviates away from the side of the lesion.

CLINICAL box

CN XII Lesions

The tongue deviates toward the side of the lesion.

Motor Exam

- **Inspection—**body position/posture
  - Involuntary movements:
    - Tremor—action, rest, postural
    - Chorea—irregular, unpredictable jerky purposeless movements that flow from one body part to another
    - Ballismus—large–amplitude, violent, flinging movements originating from proximal muscles
    - Dystonia—sustained muscle contraction → twisting sustained postures
    - Tics—repetitive, rapid, irregular, stereotyped movements or vocalizations
    - Myoclonus—rapid, shock-like, larger-amplitude movements
- **Pronator drift—**patient must keep arms up while stretched out in front of body with palms up, eyes closed. Assess for cortical weakness (positive test if arm drops and pronates)
- **Muscle tone**
  - Hypotonic
  - Normal
  - Hypertonic
    - Spastic—velocity dependent (clasp knife)
    - Rigidity—not velocity dependent (cog-wheel, lead pipe)
- **Strength**
  - Compare side to side
- **Grading scale:**
  - 0 = no muscular movement
  - 1 = trace contraction/flicker
  - 2 = movement with gravity removed
  - 3 = movement against gravity
  - 4 = movement against partial resistance
  - 5 = movement against full resistance

CLINICAL box

Muscles/Myotome/Nerves

Muscle/Movement	Myotome	Nerve
Upper Extremity		
Deltoid—arm abduction	C5	Axillary
Biceps—elbow flexion	C5/C6/C7	Musculocutaneous
Triceps—elbow extension	C6/C7/C8	Radial
Extensor carpi ulnaris/radialis—wrist extension	C5/C6/C7/C8	Radial
Flexor carpi ulnaris/radialis—wrist flexion	C6/C7/C8/T1	Ulnar/median
Hand intrinsic	C8/T1	Ulnar except LOAF = median
Lower Extremity		
Iliopsoas—hip flexion	L1/L2/L3	Femoral
Adductors—hip adduction	L2/L3/L4	Obturator
Gluteus maximus—hip extension	L5/S1/S2	Inferior gluteal nerve
Quadriceps—knee extension	L2/L3/L4	Femoral
Hamstrings—knee flexion	L5/S1/S2	Sciatic
Gastrocnemius—plantar flex ankle	S1/S2	Tibial
Tibialis anterior—dorsi flex ankle	L4/L5	Deep peroneal

Lumbricles, Opponens pollicis, Abductor pollicis brevis, Flexor pollicis brevis

- **Reflexes**
  - **Deep tendon reflexes**
    - 0 = no response
    - 1+ = requires reinforcement (Jendrassik maneuver)
    - 2+ = normal
    - 3+ = associated with spread of reflex
    - 4+ = associated with clonus
- **Cutaneous reflexes:**
  - Abdominal reflex
    - Above umbilicus (T8, T9, T10)
    - Below umbilicus (T10, T11, T12)
    - Plantar reflexes (L5, S1, S2)
  - **Other reflexes:**
    - Primitive reflexes—grasp, snout, root, etc.
    - Hoffman

CLINICAL box

DTRs

Reflex	Segmental Level	Peripheral Nerve
Biceps reflex	C5, C6	Musculocutaneous
Triceps reflex	C7, C8	Radial
Brachioradialis reflex	C5, C6	Radial
Knee jerk reflex	L2, L3, L4	Femoral
Ankle jerk reflex	S1, S2	Sciatic

CLINICAL box

Levels of Principle Dermatomes

C5—clavicle
C6—thumb
C7—middle finger
C8—ring and little finger
T4—nipples
T10—umbilicus
T12—suprapubic
L1—inguinal area
L3—knee
L4—medial side of first toe
L5—dorsum of foot
S1—lateral foot

Sensory Exam

- Check dermatomes and nerve distributions
- Pain and temperature (spinothalamic tract)
- Proprioception and vibration (dorsal columns)

Cerebellar Exam

- Upper extremity (test both sides)
  - Rapid alternating movements—assess for dysdiadochokinesia
  - Hand on hand/hand on thigh test—patient to rapidly alternate dorsal and palmer surface of hand on other hand or thigh
  - Light bulb test—have patient rapidly make motion of screwing in a light bulb
  - Tip of index finger to thumb PIP
  - Point to point movement—assess for dysmetria
  - Finger nose test—patient to use first digit to alternate between doctor's finger and patient's nose
- Lower extremity (test both sides):
  - Rapid alternating movements—assess for dysdiadochokinesia
  - Patient to tap heel on ground as fast as possible from hip
  - Point to point movement—assess for dysmetria
  - Heel to shin test

Gait Exam

- **Normal gait**—observe posture, speed, arm swing, step height, step length, ease of turning, etc.
- **Tandem gait**—may bring out ataxia
- **Walk on tip toes**—brings out gastrocnemius weakness (S1)
- **Walk on heels**—brings out anterior tibialis weakness (L5)
- **Romberg test:** The essential features of the test are as follows:
  - The subject stands with feet together, eyes open, and hands by the sides.
  - The subject closes the eyes while the examiner observes for a full minute.

This test examines a patient's balance as a result of integration of visual, vestibular, and proprioceptive function. The first stage of the test demonstrates that at least 2 of the 3 systems are intact, and that sensorimotor integration and motor pathways are functioning. In the second stage, the visual pathway is removed by closing the eyes. If the proprioceptive and vestibular pathways are intact, balance will be maintained. But if proprioception is defective, two of the sensory inputs will be absent and the patient will sway and then fall.

STEP #4

Localize the lesion and establish a DDx:

Ask yourself 3 questions:

A. What is the level of the lesion?

While knowledge of neuroanatomy is important at this step, things can be simplified further by recognizing certain patterns. The nervous system has 10 levels, each with characteristic signs and Sx that can aid in localization. From the Hx and physical exam, one should determine if the signs and Sx are more consistent with an UMN lesion (within the central nervous system) or LMN lesion (within the peripheral nervous system). This focuses what levels one should consider. Sensory findings may also be of assistance (levels 3/4/7/9/10 do not cause sensory Sx).

The 10 levels with their characteristic signs and Sx include:

- **UMN/CNS**
  1. Cortical—hemiplegia/hemianesthesia + cortical findings (aphasia, neglect, apraxia), seizures, loss of consciousness
  2. Subcortical—hemiplegia/hemianesthesia, visual field cut, no cortical findings
  3. Basal ganglia—rigidity, involuntary movement, no sensory Sx
  4. Cerebellum—ataxia, no sensory
  5. Brainstem—CN findings with (often contralateral) motor and sensory findings, loss of consciousness
  6. Spinal cord—sensory level, bowel and bladder Sx
- **LMN/PNS**
  7. Motor neuron—weakness, atrophy, fasciculations, no sensory Sx
  8. Root/plexus/nerves—variable motor/sensory Sx, areflexia
  9. Neuromuscular junction—fatigability, diplopia, ptosis, dysphagia, no sensory Sx
  10. Muscle—proximal weakness, no sensory Sx

CLINICAL box

UMN versus LMN Lesion

	UMN	LMN
Cn	Forehead sparing facial droop, CN reflexes absent, hyperactive jaw reflex	Forehead involving facial droop, fasciculations of tongue
Bulk	Normal	Decreased chronically
Tone	Increased (decreased acutely)	Decreased
Strength	Distal weaker than proximal Arm: extensors weaker than flexors Leg: flexors weaker than extensors	Patterns depend on localization of lesion.
Reflexes	Increased (decreased acutely) Plantar upgoing + ve Hoffman	Decreased Plantar downgoing

B. Is it focal or diffuse? What is the time line?

Is the lesion focal, multifocal, or diffuse? Focal refers to a discrete anatomical lesion that can explain the Sx/signs. Multifocal is multiple lesions, and diffuse refers to a widespread process.

Is the onset acute, subacute, or chronic?

C. What is the pathology?

Your answers to question B help determine the possible pathology/DDx.

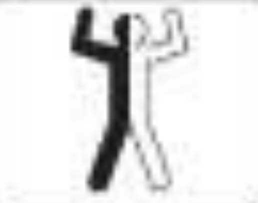
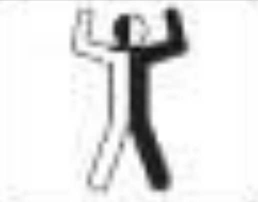
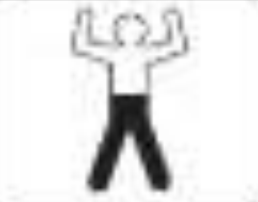
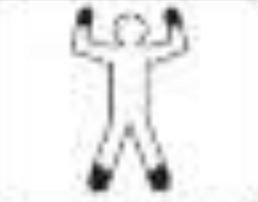
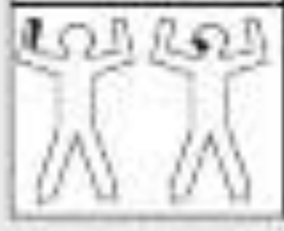
STEP #5

Investigations

- Investigations are sent based on the DDx and may include:
  - Blood work
  - Lumbar puncture

CLINICAL box

Sensory Patterns

	Cortical and Subcortical – hemianesthesia with cortical sensory findings (neglect/extinction, agraphesthesia, astereognosis)
	Brainstem – loss of pain and temperature on face ipsilateral to lesion, and on body contralateral to lesion
	Spinal Cord – loss of pain, temperature, vibration, and proprioception below sensory level affected (depending on amount of spinal cord affected)
	Polyneuropathy – stocking glove pattern (gloves don't fully appear until stockings are at knee level)
	CN/Peripheral Nerve/Plexus – loss of sensation in distribution innervated by affected nerve

  - Neuroimaging
  - EEG
  - EMG and NCS

CLINICAL box

Onset of Sx:

Seconds: stroke, migraine, seizure, trauma

Hours/days: infection/inflammation

Days/weeks: neoplasm

Weeks/months: degenerative

STEP #6

Diagnosis

- Established by combining all available information obtained previously

STEP #7

Treatment

Consists of both:

- **Nonpharmacologic**—education
  - Lifestyle modifications—diet, exercise, smoking cessation
  - Physical therapy/occupational therapy/speech therapy, etc.
- **Pharmacologic**—may be supportive, curative, or prophylactic
- **Surgical**

Must also observe closely for any complications!

Common complications in neurology include:

- Aspiration pneumonia
- DVT ± PE
- Sacral ulcers
- Urinary tract infections
- Delirium

CLINICAL box

- Distribution of Sx:
  - Focal/multifocal:
    - Trauma
    - Tumor
    - Stroke
    - Infection/inflammation
  - Diffuse:
    - Degenerative
    - Infections/inflammatory
    - Hereditary
  - Metabolic
  - Nutritional
  - Toxic

WEAKNESS

MCC ObjECTIVES

Objectives #41 (Hemiplegia, Hemisensory Loss with or without Aphasia) and #117 (Weakness, Paralysis, Paresis, and/or Loss of Motion) of *Objectives for the Qualifying Examination,* 3rd edition.

OVERVIEW

Definition

Weakness is a loss of power/strength (either partial = paresis or full = paralysis/plegia), which may occur in a variety of patterns.

APPLIED SCIENTIFIC CONCEPT

Knowledge of the corticospinal tract is crucial in localizing lesions causing weakness (see Neuroanatomy section).

APPROACH

The goal is to identify various patterns of weakness that aid in the localization and Dx of etiology, which guides treatment/management.

Step #1

Ensure the patient is stable! Patients with severe weakness especially due to peripheral neuropathy, NMJ disorders, and myopathies may have Resp distress from involvement of Resp muscles. Look at vitals, perform bedside spirometry, and assess for signs of Resp distress.

Step #2

History

Focus on characterizing the onset, progression, pattern, and associated Sx

Step #3

Physical Exam

One should perform a full neurologic assessment. For the motor exam, focus on characterizing the pattern of weakness (ensure to differentiate weakness from impaired ROM).

Step #4

Localization and DDx

Localization of weakness based on patterns and associated Sx (see Clinical Box UMN vs. LMN Lesion)

- **LMN/PNS**
  - **Muscle**—proximal muscle weakness ± muscle pain, with no sensory complaints
  - **NMJ**—fatigable weakness starting in small muscles causing ptosis, diplopia, dysphagia, dysarthria, progressing to proximal > distal weakness. No sensory complaints
  - **Peripheral nerve**—variable distributions based on mononeuropathy (focal weakness) versus polyneuropathy (symmetric, distal greater than proximal weakness)
  - **Plexus**—weakness involving multiple myotomes/dermatomes and peripheral nerve distributions
  - **Nerve root**—weakness affecting specific myotome with sensory Sx distributed along the same dermatome, often associated with neck/back pain with neuropathic radiation along the dermatome
  - **Anterior horn cell**—progressive dysphagia and dysarthria, with both UMN and LMN signs. No sensory and no bowel/bladder Sx
- **UMN/CNS**
  - **Spinal cord**—para or quadra-plegia/-paresis with a sensory level, bowel and bladder Sx ± back pain
  - **Brainstem**—hemiplegia/paresis associated with CN findings (may also have asymmetric/symmetric bilateral weakness)
  - **Subcortical CST/CBT**—hemiplegia/paresis involving face, arm, and leg equally, ± visual Sx, sensory Sx, etc.
  - **Cortical CST/CBT**—hemiplegia/paresis (ACA—mostly leg, MCA—face + arm > leg), with cortical Sx such as aphasia (dominant hemisphere), apraxia, neglect (nondominant hemisphere)

Ensure to R/O nonneurologic causes of weakness (mimics) 5 fatigue from chronic illness, deconditioning, conversion disorder, etc.

CLINICAL box

Spinal Cord Lesions

Bowel and bladder symptoms are a LATE symptom in many spinal cord lesions (e.g. neoplasms), and their absence does not rule out a spinal cord lesion.

Collaborator

In the management of all patients with weakness, physical therapy, occupational therapy, speech language pathology, and nutritionists are vital. All patients require rehabilitation until their best functional outcome is achieved. A multidisciplinary team approach is best.

Can MED

Step #5/6/7

Investigations, Dx, and Treatment (Table 13.1)

TABLE 13.1 • Workup and management of weakness based on localization

Localization	Investigations	Diagnoses	Management
Muscle Proximal muscle weakness ± muscle pain, with no sensory complaints	ESR, CRP Muscle enzymes EMG/NCS Muscle biopsy	Myositis	Immunosuppression
		Myopathy (metabolic, drug induced, etc.)	Correct metabolic derangement, D/C drug, etc.
		Rhabdo	Supportive hydration ± dialysis
		Muscular dystrophy	Nil/variable
NMJ Fatigable weakness starting in small muscles causing ptosis, diplopia, dysphagia, dysarthria, progressing to proximal > distal weakness and no sensory complaints	EMG/NCS Repetitive stimulation Single fiber EMG Tensilon test Ice pack test Anti-ACh receptor antibodies CXR/CT chest (R/O thymoma for MG)	Myasthenia gravis	ABC, admit with close monitoring of respiratory status (FVC q4h), swallowing assessment, steroids, IVIG or plasmapheresis, Mestinon, PT/OT
		Lambert-Eaton syndrome	Steroids, IVIG, plasmapheresis, chemotherapy (if caused by underlying cancer) Mestinon, Amifampridine
		Botulism toxin	Antitoxin if early, otherwise botulism immune globulin and supportive care
Peripheral nerve Variable distributions based on mononeuropathy (focal weakness) vs. polyneuritis (symmetric distal greater than proximal weakness)	EMG/NCS LP Medication review Thorough SHx (drugs, sexual Hx, EtOH, etc.) FBS, TSH, Vit B_{12}, LFT, Cr/BUN, infectious, vasculitic, nutritional workup as necessary Note: MRI L spine if presumed cauda equina	**AIDP = GBS**	**ABC, admit with close monitoring of respiratory status (FVC q4h), plasmapheresis or IVIG, PT/OT**
		CIDP	Corticosteroids Plasmapheresis or IVIG
		Medication/drug induced	Stop med/drug
		Diabetes	Optimize glycemic control
		Thyroid D/O	Correct thyroid abnormality
		Vit B_{12} deficiency	Vit B_{12} supplementation
		Vasculitis	Immunosuppression
		Infections (Lyme, diphtheria)	Treat accordingly
		Trauma	Surgery if indicated, rehabilitation
		Cauda equina 2° compression	Urgent NSx/radiation (if tumor)
Plexus Weakness involving multiple myotomes/dermatomes and peripheral nerve distributions	MRI of plexus EMG/NCS FBS	Brachial neuritis Trauma	Supportive therapy
		Diabetes	Optimize glycemic control
Root Weakness affecting specific myotome with sensory symptoms distributed along the same dermatome, often associated with neck/back pain with neuropathic radiation along the dermatome	X-ray/CT/MRI of spine EMG/NCS	Herniated disc OA/degenerative disc disease Avulsion Tumor	Supportive therapy PT/OT Consult NSx/ortho

(Continued)

TAbLE 13.1 • Continued

Localization	Investigations	Diagnoses	Management
Anterior horn cell Classic diseases causing progressive dysphagia, dysarthria, with both UMN and LMN signs with no sensory and no bowel/bladder Sx	El Escorial criteria R/O other possible localizations/disorders	Amyotrophic lateral sclerosis Primary lateral sclerosis Primary muscular atrophy Progressive bulbar palsy Pseudobulbar palsy	Supportive therapy
Spinal cord Para or quadra-plegia/-paresis with a sensory level, bowel and bladder symptoms ± back pain	MRI + gadolinium of spinal cord LP—cell count, cytology, flow cytometry, infx Infx w/u—syphilis, CMV, HTLV, mycoplasma, HSV, VZV, HIV, etc. Paraneoplastic antibodies	Trauma	Consult NSx
		MS	Steroids ± disease modifying therapy
		Transverse myelitis	Steroids
		Neoplasm/metastases	Consult NSx, med/rad oncology
		Vascular	Optimize vascular risk factors
Brainstem Hemiplegia/paresis associated with CN findings (may also have asymmetric/symmetric bilateral weakness)	MRI brain Investigations vary depending on MRI results.	Stroke (ischemic/hemorrhagic)	See section on Stroke
		Other vascular causes—AVM, aneurysm, etc.	Consult NSx
		Mass lesion—neoplasm (1° vs. met)	Consult NSx/oncology Search for primary
		Infection—abscess (bacterial, fungal, parasite)	Abx/antifungals/antiparasitics Consult ID
		MS	Steroids ± disease modifying therapy
Subcortical Hemiplegia/paresis involving face, arm, and leg equally, ± visual Sx, sensory Sx, etc.	CT/MRI brain Investigations vary depending on imaging.	Stroke (ischemic hemorrhagic)	See section on Stroke
		Other vascular causes—AVM, cavernoma, etc.	Consult NSx
		Mass lesion—neoplasm (1° vs. met)	Consult NSx/oncology Search for primary
		Infection—abscess (bacterial, fungal, parasite)	Abx/antifungals/antiparasitics Consult ID
		MS	Steroids ± disease modifying therapy
		Trauma—contusion	Consult NSx/supportive
Cortical Hemiplegia/paresis (ACA—mostly leg, MCA—face + arm > leg), with cortical Sx such as aphasia (dominant hemisphere), apraxia, neglect (nondominant hemisphere).	CT/MRI brain Investigations vary depending on imaging	Stroke (ischemic or hemorrhagic)	See section on Stroke
		Other vascular causes—AVM, aneurysm, etc.	Consult NSx
		Mass lesion—neoplasm (1° vs. met)	Consult NSx/oncology Search for primary
		Infx—abscess, encephalitis (bacterial, viral, fungal, parasite)	Abx/antifungals/antiparasitics/antivirals Consult ID
		Trauma—contusion, SDH, etc.	Consult NSx/supportive
		Other causes with no imaging findings—Todd paralysis, hemiplegic migraine, hypoglycemia	Treat according to cause (e.g., supportive care for Todd paralysis, analgesia for migraine, and glucose for hypoglycemia)

STROKE

MCC OBJECTIVES

Based on Objectives #41 (Hemiplegia, Hemisensory Loss with or without Aphasia) and #117 (Weakness, Paralysis, Paresis, and/or Loss of Motion) of *Objectives for the Qualifying Examination,* 3rd edition.

OVERVIEW

Stroke is one of the most common diseases a neurologist deals with and all physicians will encounter it at one point of their career or another. As such a special section is devoted to it. See Figure 13.2 for classification of stroke.

APPLIED SCIENTIFIC CONCEPT

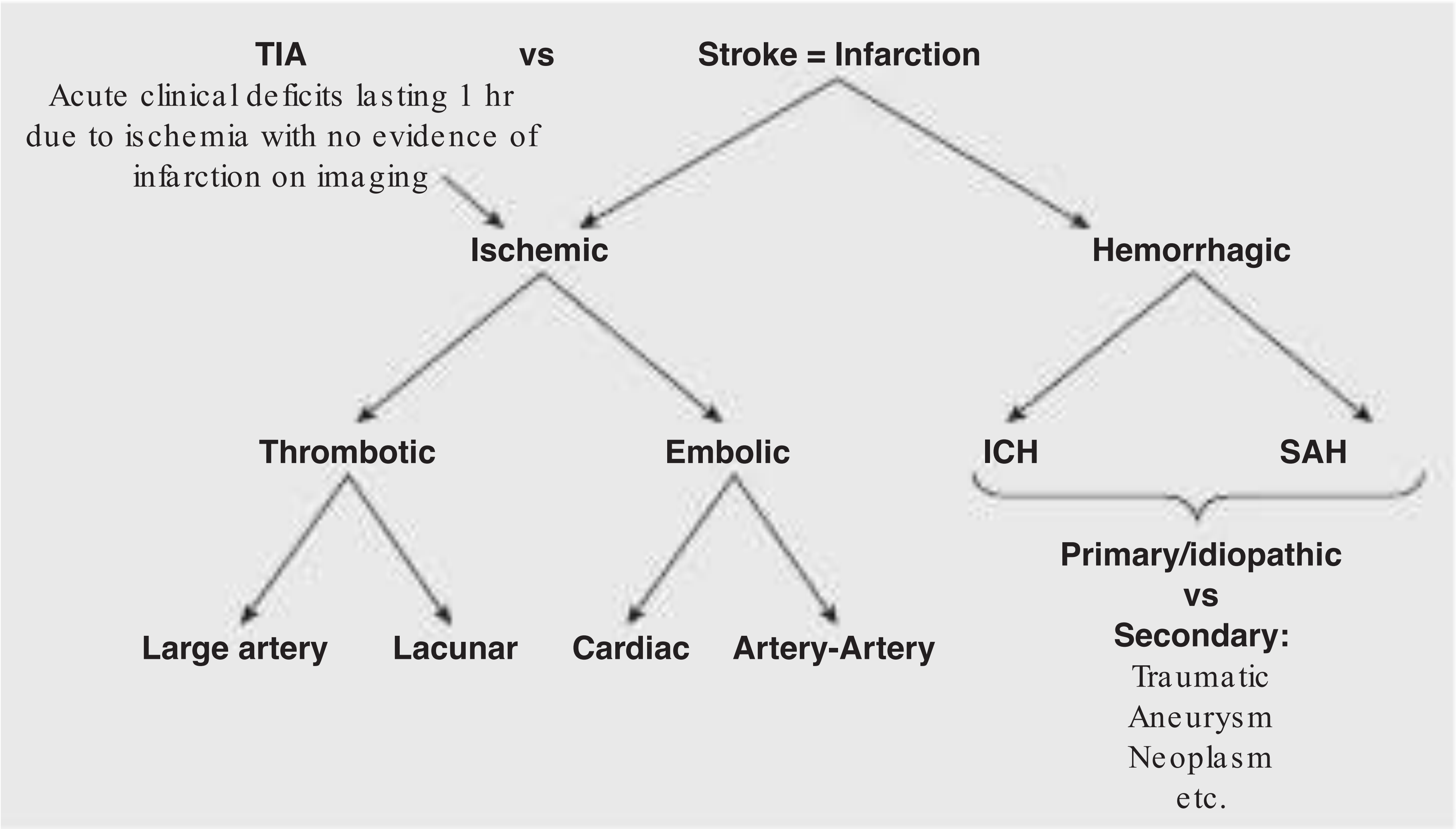


Figure 13.2. Classification of stroke.

APPROACH

Step #1

Ensure the patient is stable—patients presenting with strokes (especially hemorrhagic strokes) can be quite sick, so ensure ABCs are secured prior to any further steps.

Step #2/3

Hx and Physical Exam

Time of onset and progression are important.

Note: if patient is less than 4.5 h from onset, they are within the window for acute treatment with tPA.

One should also characterize the deficits on Hx and physical exam. A thorough risk factor assessment is important, as is a thorough systemic exam to help predict the etiology of the stroke.

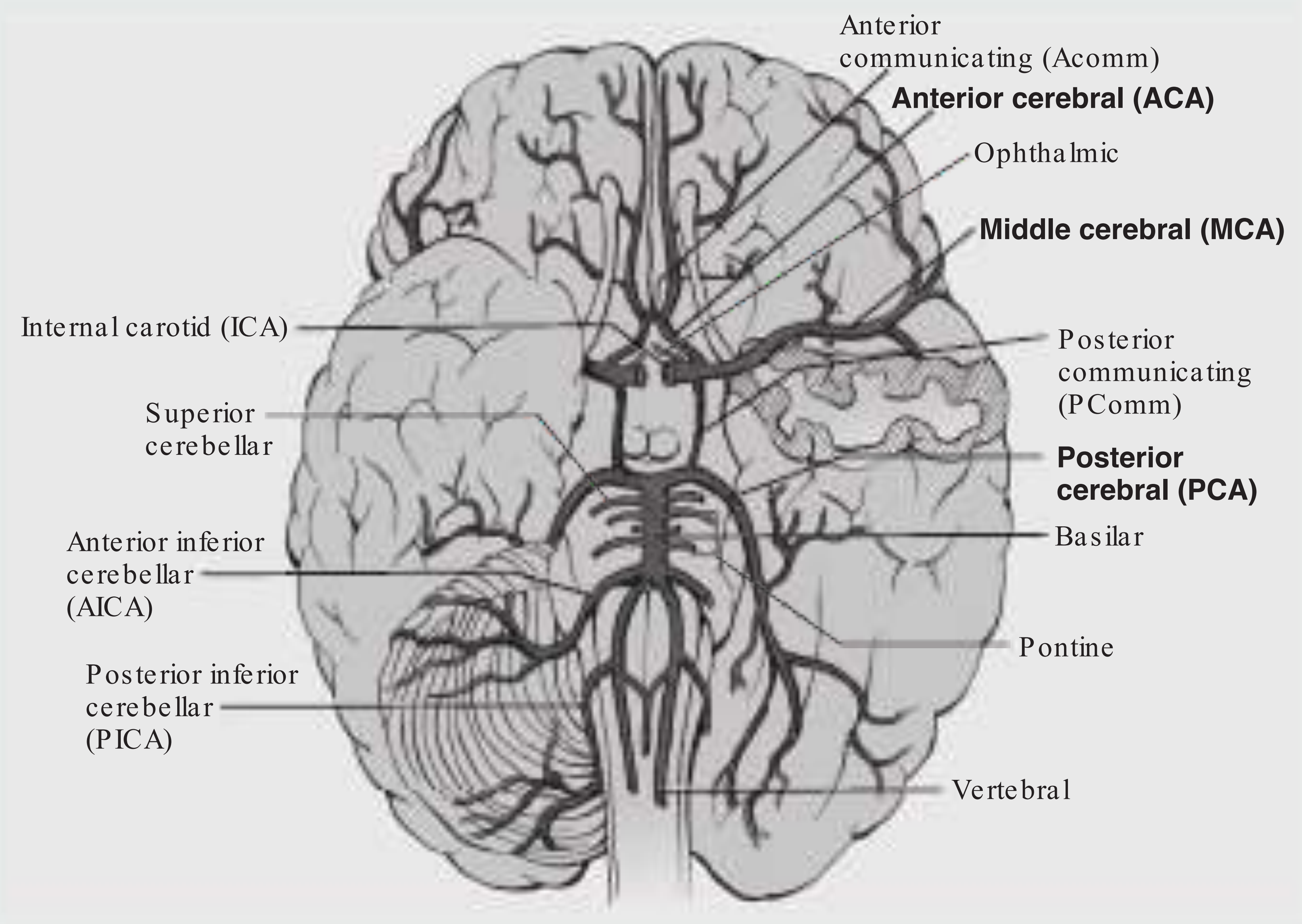
- **Hemorrhagic stroke risk factors**
  - HTN
  - Smoking
  - Increased age
  - FHx
  - Atherosclerosis
  - Bleeding disorders
  - Increased EtOH consumption
  - Cocaine, amphetamines

ASC box

CNS Vascular Anatomy

Knowledge of the vascular and functional anatomy of the brain may help one localize stroke syndromes (acute onset weakness due to an ischemic/hemorrhagic infarct in a known arterial territory) even more accurately.

- ACA—contralateral leg > face/arm involvement
- MCA—contralateral face/arm > leg involvement
  - Dominant hemisphere—aphasia
  - Nondominant hemisphere—apraxia, neglect
- PCA—contralateral visual loss
- Basilar—variable syndromes involving weakness, CN (diplopia, dysphagia, dysarthria), and cerebellar (ataxia) Sx


Anterior communicating (Acomm)
Anterior cerebral (ACA)
Ophthalmic
Middle cerebral (MCA)
Internal carotid (ICA)
Posterior communicating (PComm)
Superior cerebellar
Posterior cerebral (PCA)
Anterior inferior cerebellar (AICA)
Basilar
Pontine
Posterior inferior cerebellar (PICA)
Vertebral

  - Trauma
  - Vasculitis
  - Aneurysm
  - AVM
  - Tumor
  - Amyloid angiopathy
- **Ischemic stroke risk factors**
  - Increased age
  - Smoking
  - DM
  - Hyperlipidemia
  - HTN
  - AFib
  - Previous stroke/TIA
  - FHx
  - Other cardiac sources
  - Atherosclerosis
  - Obesity/physical inactivity
  - OCP/HRT
  - OSA

  - Elevated homocysteine
  - Ethnicity
  - Hypercoagulable state
  - Hypoperfusion
- **Physical exam findings useful in predicting the etiology of stroke**
  - Retinal hemorrhages—HTN and diabetic retinopathy
  - Purpura, ecchymosis—platelet disorder, coagulation D/O, vasculitis
  - Carotid bruit—extracranial carotid stenosis
  - Retro-orbital bruit—intracranial atherosclerosis
  - Osler nodes, Janeway lesions, Roth spots, splinter hemorrhages, petechial—endocarditis
  - DVT findings (in combination with PFO)—thromboembolism
  - Irregularly irregular pulse (AFib)—cardioembolic

Step #4

Localize the Lesion

After convincing yourself that the patient is experiencing a stroke, one must localize the lesion. In stroke, there are two localizations: anatomical and vascular (see Applied Scientific Concept).

Step #5

Investigations

- **Purpose: confirm Dx and type of stroke**
  - Noncontrast CT head—always done. Differentiates hemorrhagic from ischemic stroke (acute blood is white on CT). Faster as an initial screen in patients with acute Sx, less susceptible to motion artifact, and cheaper than MRI.
  - LP—if suspicious of SAH and CT head negative (95% sensitive), must perform LP looking for RBC and xanthochromia
  - MRI—can also be used to determine type and localization of stroke (especially for acute ischemic infarcts and for posterior fossa stokes)
- **Purpose: determine stroke etiology**
  - Carotid Doppler U/S—rapid, noninvasive, dye-free initial assessment of carotid artery stenosis. High sensitivity and specificity for carotid stenosis > 50%. Does not accurately assess stenosis < 50%, nor does it assess vertebral circulation.
  - CT angiography—excellent for imaging atherosclerosis and dissection in carotid, vertebral, and basilar arteries, as well as assessing for aneurysms. Highly effective for identifying site of intracranial vascular lesions. Requires injection of dye (potentially nephrotoxic).
  - MRI angiography—useful in identifying AVMs, aneurysms, and carotid circulation
  - Conventional angiography—gold standard for identifying AVMS and aneurysm, but is invasive and requires dye injection
  - TTE—noninvasive examination of the heart for cardiac sources of emboli and wall motion abnormalities
  - TEE—typically performed after TTE. Is invasive but has better yield in detecting atrial thrombi, atheromatous aortic disease, valve disease, and PFO.
  - Holter
  - Hypercoagulable w/u—can detect hypercoagulable states that may make patients prone to strokes and other thrombotic events
- **Purpose: Assess stroke risk factors and prepare for 2° prevention**
  - Fasting blood glucose (HbA_{1c} if known DM)
  - Fasting lipids
  - BP monitoring
  - Smoking/EtOH/drug assessment
  - CBC, INR, PTT, lytes, Cr, BUN
  - LFT, CK (prior to starting statin)

Step #6

Diagnosis

Once investigations are complete, one should be able to determine the etiology of the stroke (see Figure 13.2).

Step #7

Treatment/Management

Ischemic Stroke

- Acute treatment—IV tPA only if within 4.5 h from onset and no contraindications
  - BP lowering (if necessary, target < 220/120 mmHg in pts NOT given tPA, or < 180/105 mmHg if given tPA)
  - ASA 160 mg chewed or 650 mg PR (if unable to swallow)
- Rehabilitation—SLP/OT/PT, etc.
- 2° prevention
  - Pharmacologic: antiplatelet—ASA 81 mg PO daily, or Plavix 75 mg PO daily, or Aggrenox (Dipyridamole 200 mg + ASA) b.i.d.
    - Anticoagulation—only for patients with AFib as cause of stroke. Warfarin target INR 2.0 to 3.0
      - New direct thrombin (Dabigatran) and factor X inhibitors (Rivaroxaban or Apixaban) also available
    - DM—maintain tight glycemic control with OHG or insulin. Target HbA_{1c} < 7%
    - Lipids—use statins to achieve a target LDL < 2.0 or TC/HDL < 4.0
    - BP—first line = ACEI/ARB (perindopril) or diuretic (indapamide). Target < 140/90 mm Hg or < 130/80 mm Hg if DM.
  - Nonpharmacologic—lifestyle modifications (smoking cessation, regular exercise, weight loss, dietary modifications, reduced EtOH consumption)
  - Surgical—refer to NSx for carotid endarterectomy/stenting if symptomatic (patient had stroke/TIA) > 50% stenosis, nondisabling stroke, and acceptable surgical risk
- Complication prevention:
  - DVT prophylaxis
  - Proper positioning and regular mobilization to prevent pressure ulcers and contractures
  - Swallowing screens and modified diets to prevent aspiration pneumonia

CLINICAL box

Absolute:

- Intracranial Hemorrhage
- Severe Uncontrolled HTN
- Head Trauma/Stroke in last 3 mths
- Thrombocytopenia/Coagulopathy
- Therapeutic anticoagulation (esp. LMWH in last 24h)

Relative:

- Age > 75-80 yrs
- Improving Stroke Symptoms
- Coma/Severe Stroke (use caution due to higher risk of hemorrhagic transformation)
- Recent Major Surgery
- Recent GI/GU Bleed (within 3 weeks)
- Seizures
- Recent MI
- CNS Structural Lesions (e.g. neoplasm, AVM, aneurysm)

Hemorrhagic Stroke

- **ICH**—ABC (intubate and sedate if necessary), reverse coagulation abnormality, supportive care, NSx consultation (for surgical evacuation or ICP monitoring—if midline shift, mass effect, or potential herniation). ICP management may include hyperventilation, sedation/paralysis, CSF drainage, elevating head of bead 30 to 40 degrees, lasix, hyperosmotics (mannitol or hypertonic saline), decompressive craniectomy.
- **SAH**—ABC (intubate and sedate if necessary), reverse coagulation abnormality, aggressive BP control (SBP < 160 mm Hg), urgent angiographic imaging, SAH precautions, nimodipine, consult NSx, definitive management of underlying cause (e.g., aneurysm)

SENSORY COMPLAINTS

MCC ObjECTIVES

Based on Objectives #66 (Numbness/Tingling/Altered Sensation), #67 (Pain), #67-2-1 (Sympathetic/Complex Regional Pain Syndrome/Reflex Sympathetic Dystrophy), #67-2-2 (Central/Peripheral Neuropathic Pain), #67-1-2-1 (Generalized Pain Disorders), and #109-11 (Nerve Injuries) of *Objectives for the Qualifying Examination,* 3rd edition.

OVERVIEW

Definitions

Sensory complaints may include:

- **Positive sensory complaints**—paresthesia/dysesthesia = tingling, pins and needles, burning, neuropathic pain
- **Negative sensory complaints**—hypoesthesia/anesthesia = numbness, diminution/absence of feeling

APPLIED SCIENTIFIC CONCEPT

Knowledge of the spinothalamic and dorsal column pathways is crucial in localizing sensory lesions (see Neuroanatomy section).

APPROACH

Goal is to identify various patterns of sensory Sx that aid in the localization and Dx of etiology, which guides treatment/management.

Step #1

- Ensure the patient is stable

Step #2

Hx

- Onset and progression are important. Next, one should delineate the pattern and type of sensory complaint (positive or negative), and the modality (pain, temperature, proprioception, vibration). Associated Sx such as back pain, weakness, bowel/bladder complaints, as well as functional limitations.

Step #3

Physical Exam

The pattern and type of sensory complaint is key to determining localization.

Step #4

Localization

Sensory patterns and localization (see Clinical Box Peripheral Nerve Injuries—Seddon Categories)

Step #5

Investigations/Dx/Management (Table 13.2)

TABLE 13.2 • Workup and management of sensory complaints based on localization

Localization	DDx	Investigations	Management
Cortical/subcortical and brainstem	Vascular (CVA, ICH, SAH) Inflammatory (MS) Neoplasm (1° vs. met) Infection	CT head MRI brain (need MRI to assess brainstem if suspected) ± LP	Treat underlying etiology
Spinal cord	Vascular (cord infarction) Neoplasm (1° vs. met) Inflammatory (MS) Infection (syphilis) Nutritional deficiency (B_{12}) Trauma Syringomyelia Paraneoplastic	MRI cord ± LP Other tests may include: serology for various infections, Vit B_{12}, paraneoplastic antibodies	Treat underlying etiology: optimize vascular RF Consult NSx/rad oncology if mass present Steroids for inflammation ABx for infections Replace deficiencies Steroids/PLEX and Rx underlying cancer if paraneoplastic
Polyneuropathy	Metabolic (DM, uremia) Drug (chemo, EtOH) Infection (HIV, Lyme) Paraneoplastic Inflammatory (amyloid, sarcoid vasculitis) Heritable Idiopathic	EMG/NCS Other test may include: FBS, Cr, BUN, TSH, AST, ALT, serology for various infections, CD4 count, inflammatory w/u including ESR/CRP, paraneoplastic antibodies	Treat underlying etiology: optimize DM, kidney function, and liver function D/C offending drug Rx infection Steroids/PLEX and Rx underlying cancer if paraneoplastic Steroids, etc. for inflammatory causes
Mononeuropathy	Stretch Compression (e.g., CTS) Contusion Laceration **Note:** peripheral nerve injuries often occur as part of more extensive injuries and tend to go unrecognized	EMG/NCS Sometimes imaging studies are needed as well as FBS, Cr, BUN, TSH, AST, ALT, serology for various infections, CD4 count, inflammatory w/u including ESR/CRP, paraneoplastic antibodies	Task modification, splints, PT/OT, ergonomics If severe/axonal loss on EMG/NCS consider surgical release Consult plastic surgery to manage nerve injuries

A bRIEf NOTE ON TWO COMMON SENSORY DISORDERS

Neuropathic Pain

Definition

Pain resulting from dysfunction/disruption of either the central or peripheral nervous system. It may be perceived as allodynia (painful responses to a stimulus which is not normally painful), hyperalgesia (increased pain in response to a stimulus which is normally painful), or just a constant pain (burning, sharp, stabbing, shooting, or electrical in quality). See Clinical Box, Differentiating Various Types of Pain.

CLINICAL box

Differentiating Various Types of Pain

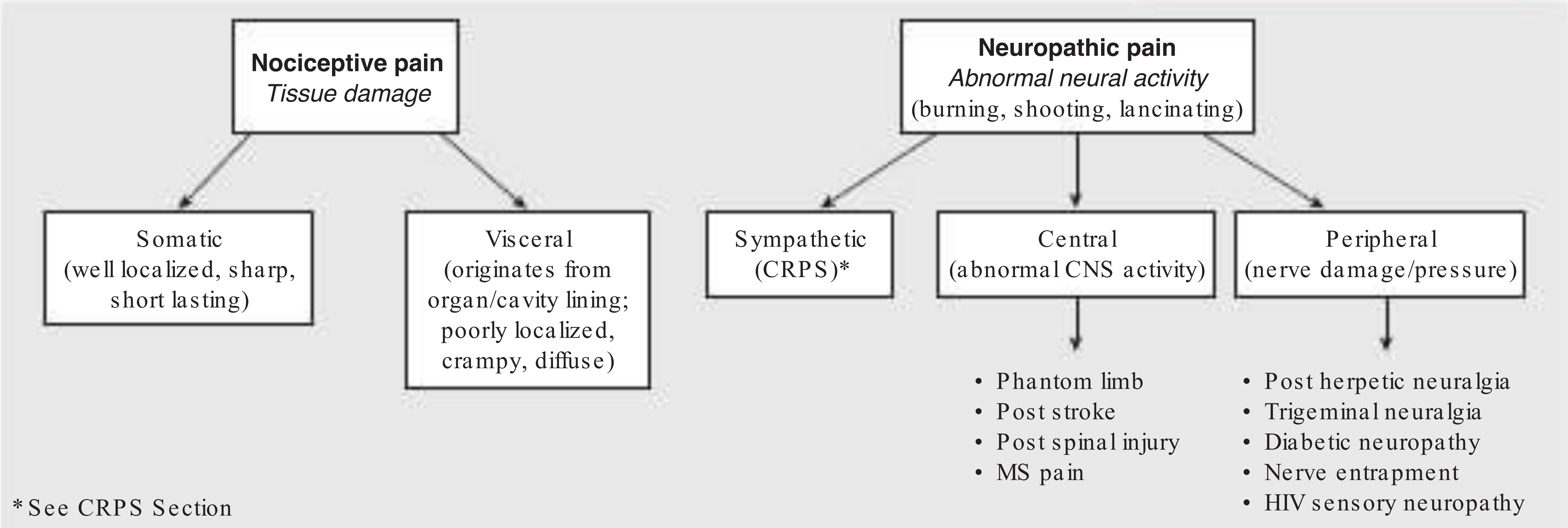
	Neuropathic Pain	Vascular Pain
Location	Distal (feet, ankles)	Calves
Timing	Constant	With activity
Perception	Sharp, burning, tingling	Deep pain
At rest	Worse	Better

CLINICAL box

Peripheral Nerve Injuries—Seddon Categories

- Neurapraxia (focal demyelination)
  - Temporary conduction block/paralysis occurs.
  - Complete recovery is typical.
- Axonotmesis (axonal destruction with preservation of myelin)
  - Prolonged conduction block/paralysis
  - The recovering axon can follow an intact myelin base to reestablish connectivity.
  - Complete recovery is possible.
- Neurotmesis (complete transection)
  - Prolonged/permanent conduction block/paralysis
  - Loss of myelin base to guide axon
  - Neuroma formation results.
  - Complete recovery unlikely without surgery

Causal Conditions of Neuropathic Pain (Figure 13.3)



*See CRPS Section

Figure 13.3. Causal conditions of neuropathic pain.

Management of Neuropathic Pain

- See Figure 13.4

Complex Regional Pain Syndrome (CRPS)

Definition

A condition of chronic neuropathic pain, developing over months, which affects an extremity and **cannot be localized to a peripheral nerve or root territory.** It may or may not have an obvious etiology. All tissue types in the vicinity are affected. Severe and permanent changes may occur within 1 yr of disease onset (Table 13.3).

- Type I—no definable lesion/insult, previously known as reflex sympathetic dystrophy
- Type II—a definable lesion/insult, previously known as "causalgia"

Causes include trauma, head injury, stroke, infection, idiopathic, MI, etc.

Investigations

The Dx of CRPS is based largely on the clinical Hx and exam, but investigations may include:

- Plain radiographs—detect patchy/localized bone demineralization during the chronic stage (> 1 yr)

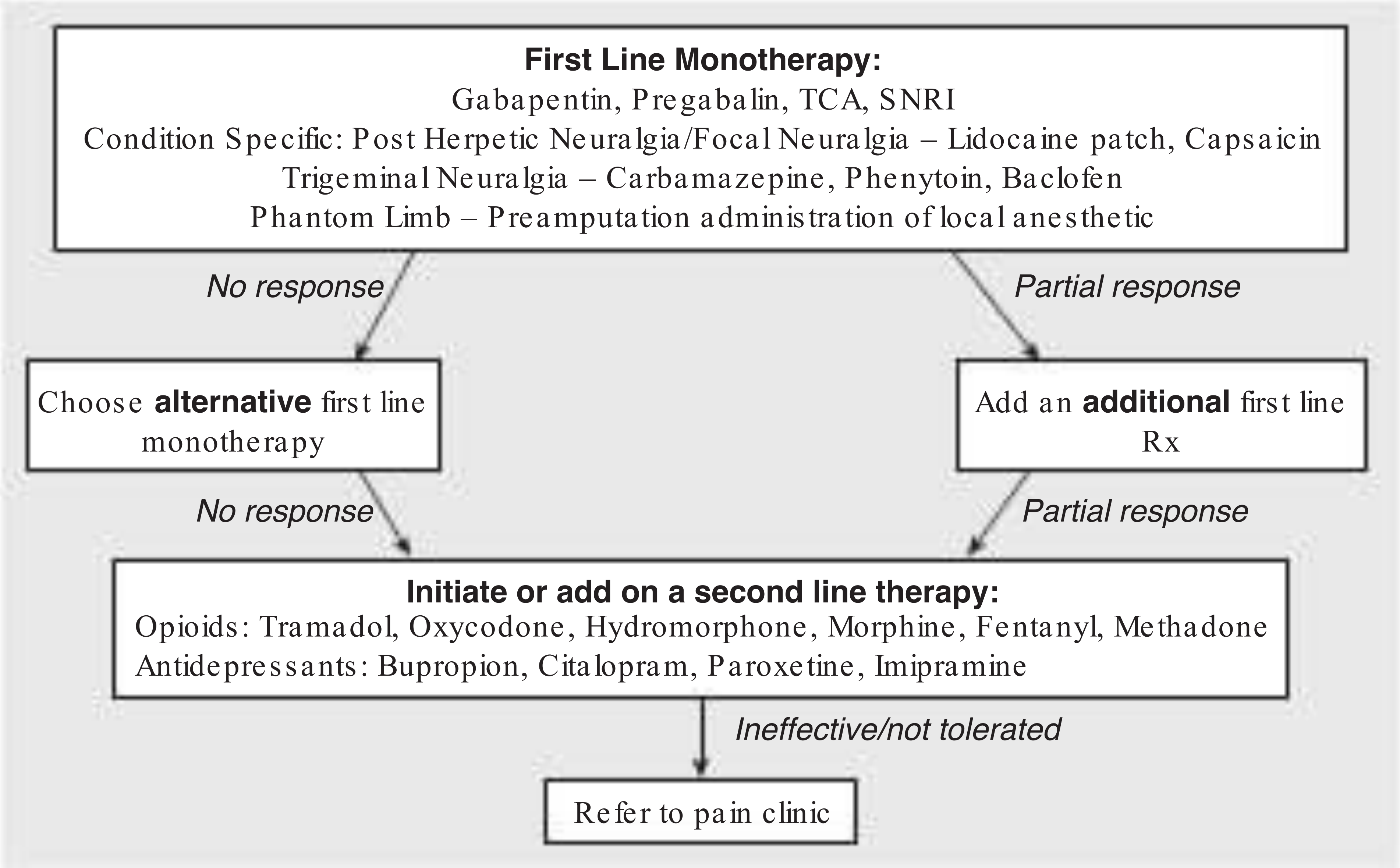

First Line Monotherapy:
Gabapentin, Pregabalin, TCA, SNRI
Condition Specific: Post Herpetic Neuralgia/Focal Neuralgia – Lidocaine patch, Capsaicin
Trigeminal Neuralgia – Carbamazepine, Phenytoin, Baclofen
Phantom Limb – Preamputation administration of local anesthetic
No response
Partial response
Choose alternative first line monotherapy
Add an additional first line Rx
No response
Partial response
Initiate or add on a second line therapy:
Opioids: Tramadol, Oxycodone, Hydromorphone, Morphine, Fentanyl, Methadone
Antidepressants: Bupropion, Citalopram, Paroxetine, Imipramine
Ineffective/not tolerated
Refer to pain clinic

Figure 13.4. Management of neuropathic pain.

TABLE 13.3 • Clinical findings in CRPS (in addition to neuropathic pain, allodynia, hyperalgesia[a])

Vasomotor/Sudomotor[b]	Skin	Hair/Nails	Muscle and Joints	Bone
Edema	Thickened	Increased hair growth, then loss	Wasting	Patchy, then severe demineralization
Change in color, red, then cyanotic	Mottled Contractures	Nails grow fast, then slow	Reduced strength Stiffening Reduced ROM	
Change in temp: warm, then cool. Hyper, then hypohidrosis				

[a] Allodynia and hyperalgesia occur early in the onset, but tend to fade after a year.

[b] Vasomotor and sudomotor activities are initially subject to increased blood flow, followed by decreased blood flow, as mediated by abnormal SNS activity.

- Bone scintigraphy—mineralization phase shows increased uptake during the subacute stage (< 1 yr)
- Regional sympathetic nerve block—can be diagnostic and therapeutic. Degree of pain relief and improvement in clinical Sx suggest both the degree of SNS involvement and the potential benefit of permanent sympathectomy.

Management

Unfortunately few treatments exist for CRPS. They include:

- Prevention—early mobilization after injuries, strokes, etc.
- Vitamin C
- Regional nerve blocks
- Sympathectomy

SPEECH AND LANGUAGE ABNORMALITIES

MCC OBJECTIVE

Based on Objective #44 (Language and speech disorders) of *Objectives for the Qualifying Examination,* 3rd edition.

OVERVIEW

Definitions

- **Dysarthria**—abnormality of speech. A problem with articulation due to a lesion in the motor pathways controlling speech. Any of the speech subsystems (respiration, phonation, resonance, prosody, and articulation) can be affected, leading to impairments in intelligibility, audibility, naturalness, and efficiency of vocal communication. **Note:** Often accompanied by oropharyngeal dysphagia.
- **Aphasia**—abnormality of language, caused by a lesion in the dominant hemisphere. Sx may include paraphasic errors (mispronounced or inappropriately substituted words), including semantic (based on meaning) or phonemic (based on sounds) errors as well as neologisms (creation of new words).

APPLIED SCIENTIFIC CONCEPT (Figure 13.5)

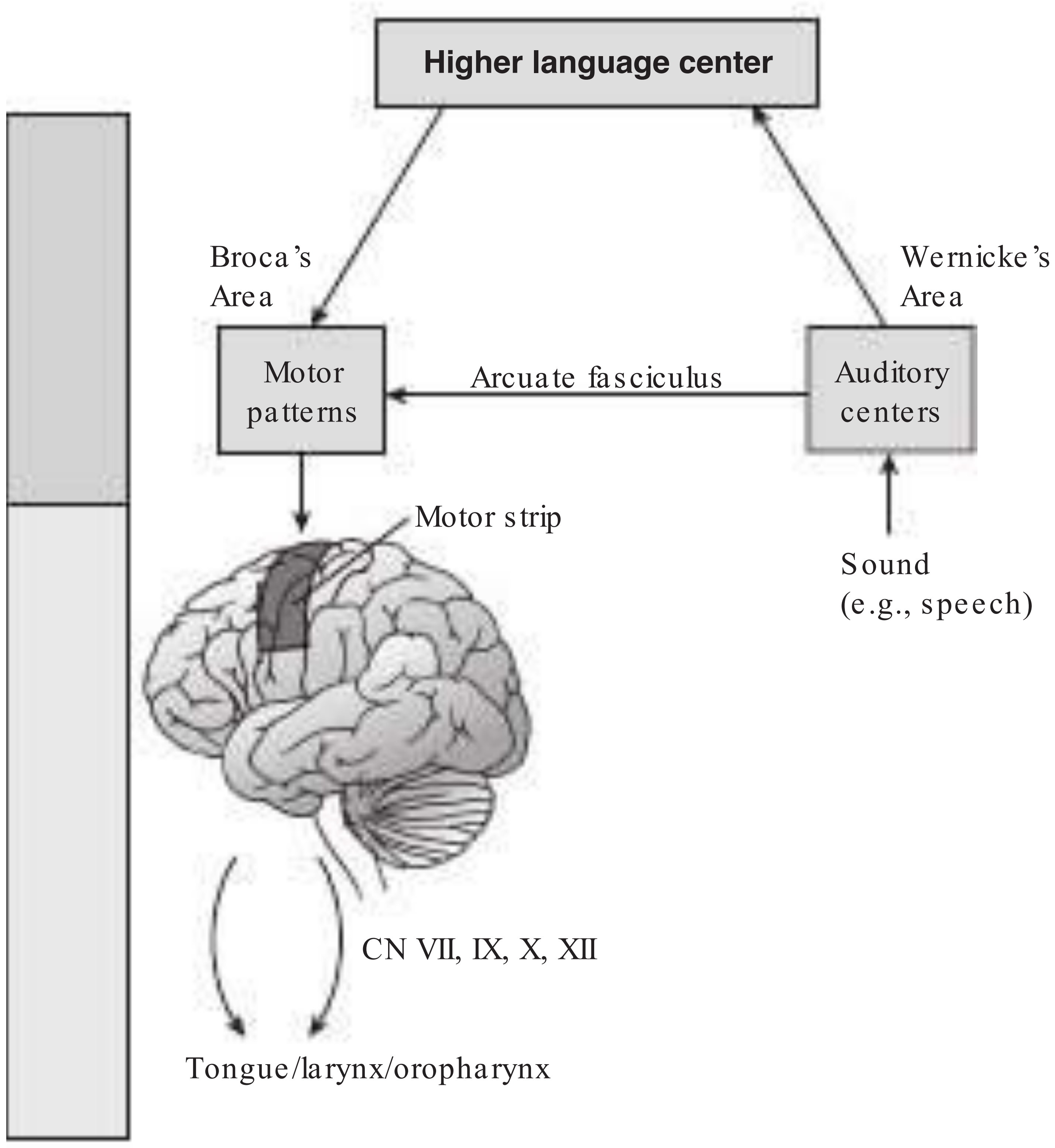


Figure 13.5. Aphasia versus dysarthria and anatomic correlates.

APPROACH

Step #1

Ensure the patient is stable—one of the most common etiologies of dysarthria and aphasia is stroke (both ischemic and hemorrhagic), so one must ensure patients are stable prior to proceeding with assessment.

Step #2

Hx

Onset is important to delineate, as is whether or not the patient is struggling with dysarthria, aphasia, or both. Associated Sx such as oropharyngeal dysphagia, other CN Sx, weakness, sensory Sx, or cerebellar Sx.

Step #3

Physical Exam

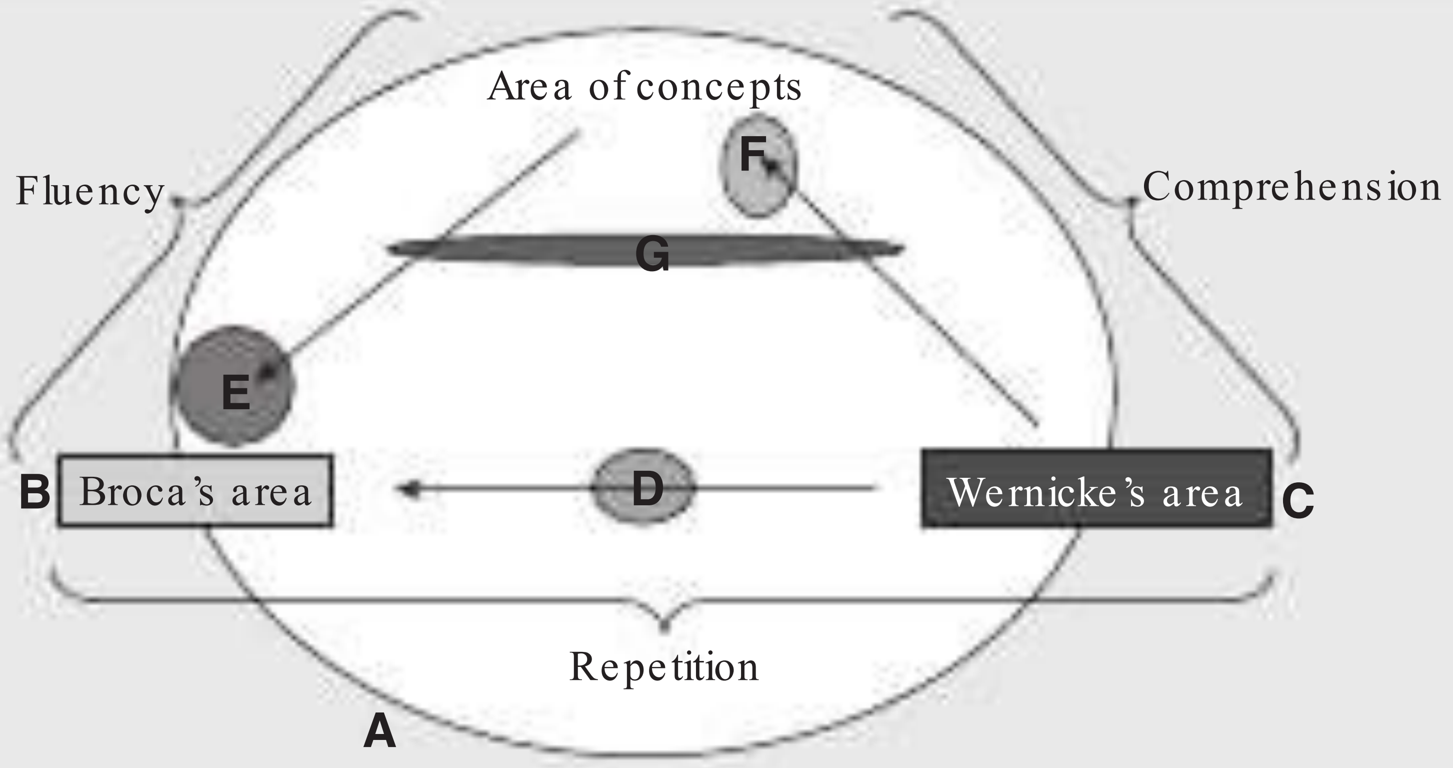
A thorough language and speech exam should be conducted as should the remainder of the neurologic exam to assess for any other focal neurologic deficits.

- **Fluency—**verbal output/unit time. Test with open-ended questions (“what did you have for breakfast?” or get them to describe a picture)
- **Naming—**test both high- and low-frequency words
- **Comprehension**—test ability to follow commands (1 step—point to roof, 2 steps—close eyes and point to roof, 3 steps—open mouth, close eyes, and point to roof)
- **Repetition**—repeat after me … (simple—“hello,” intermediate—“I am here,” complex—“no ifs ands or buts” or “the prime minister lives in Ottawa.”)
- Reading
- Writing
- **Articulation—**have patient say mama (CN VII), gaga/caca (CN IX/X), and lala (CN XII)
- **Quality**—listen to the quality of the patients voice

Step #4

Localization and DDx

Localization and possible etiologies vary depending on whether the patient is suffering from dysarthria or aphasia (Figure 13.6 and Table 13.4).



Relationship between Wernicke’s area, Area of concepts, and Broca’s area. Letters flag potential areas of disruption.

	Type of Aphasia	Fluency	Naming	Comprehension	Repetition
A	Global aphasia	X	X	X	X
B	Broca’s aphasia	X	X		X
C	Wernicke’s aphasia		X	X	X
D	Conduction aphasia		X		X
E	Transcortical motor aphasia	X	X		
F	Transcortical sensory aphasia		X	X	
G	Transcortical mixed aphasia	X	X	X	

Note: anomia = common in all aphasias

Dx: depends on timeline
sec-min = Vascular
hrs-day = Infection
days = Inflammation
wks-mths = Neoplasm
mths-yrs = Degerative

Investigations:
Neuroimaging – CTa or MRI brain +/− LP, EEG, etc.

Management:
Treat underlying etiology accordingly.
Supportive care is also important including modified diet and SLP.

Figure 13.6. Localization investigations and management of aphasia.

Step #5/6/7

Investigations/Dx/Management (see Figure 13.6 and Table 13.4)

TAbLE 13.4 • Workup and management of dysarthria based on localization

Localization/Etiology	Investigation	Management
Cerebral cortex Basal ganglion (hypophonation) Cerebellum (scanning speech) Brainstem (other brainstem findings) Vascular Inflammatory Infection Neoplasm Trauma	Neuroimaging such as CT head or MRI brain LP and other serum tests may be necessary	Treatment depends on cause See section on Weakness
Isolated CN palsies CN VII—Bell palsy CN IX/X—structural CN XII—structural	MRI brain EMG/NCS	Treatment depends on cause
Motor neuron (spastic/hypernasal) Degenerative	Diagnostic criteria and R/O other possibilities	Supportive care
NMJ (fatigable) MG	Tensilon/ice pack test, Anti-AChR antibody, etc. NCS with repetitive stimulation Single fiber EMG	See management of MG in section on Weakness
Muscle Inflammatory Metabolic Drug/toxin induced Genetic	EMG/NCS, CK, etc.	Supportive care and treat curable causes
Larynx/respiratory system (hypophonic) Structural	Laryngoscopy, CXR, PFT, etc.	Consult ENT/pulmonary as necessary

MOVEMENT DISORDERS

MCC ObjECTIVE

Based on Objective #61 (Movement Disorders, Involuntary/Tic Disorders) of *Objectives for the Qualifying Examination,* 3rd edition.

OVERVIEW

Definition

Movement disorders consist of a variety of disorders resulting from disease of the basal ganglia and/or cerebellum, due to an assortment of etiologies. Two broad categories exist:

- **Hyperkinetic:** disorders in which patients suffer from abnormal movements
- **Hypokinetic:** disorders in which patients suffer from a lack/paucity of normal movements

APPLIED SCIENTIFIC CONCEPT (Figure 13.7)

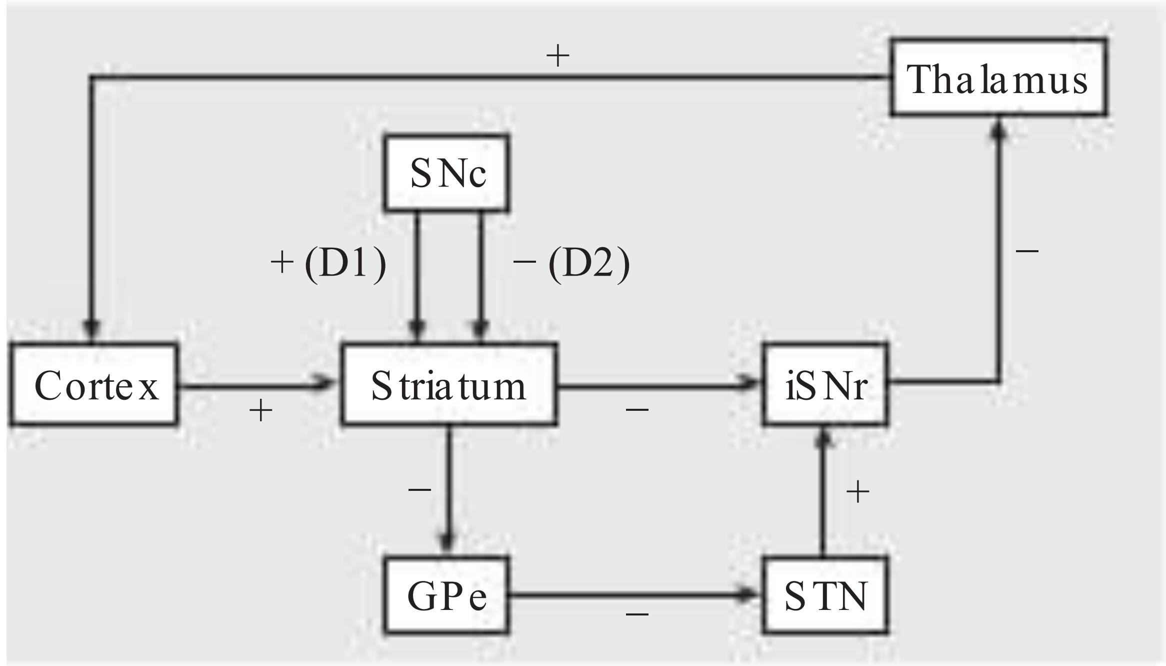


Figure 13.7. Circuitry of the basal ganglia.

APPROACH

First one must determine the type of movement disorder the patient is experiencing. The next step is to determine the etiology. Treatable disorders must be identified.

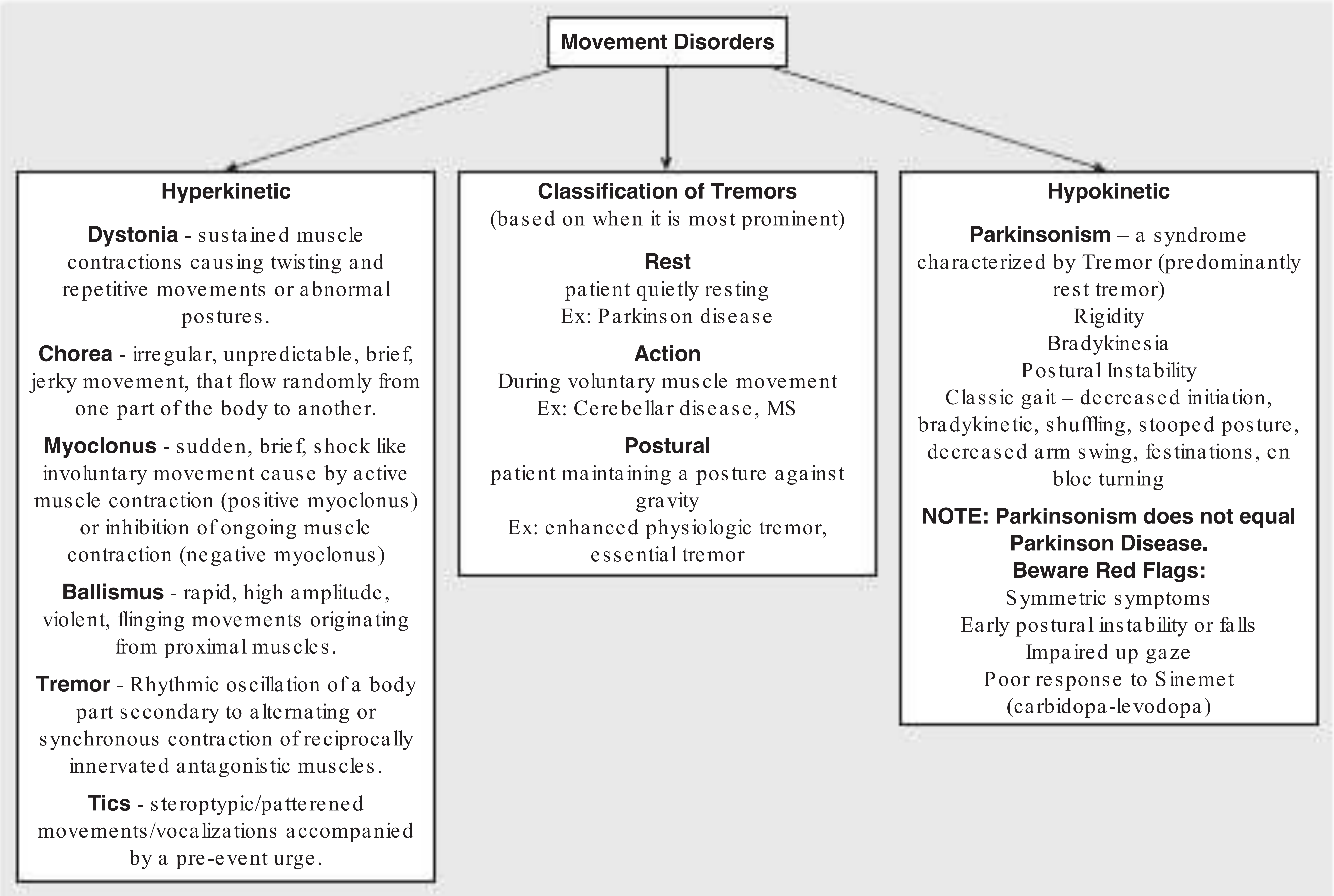
Step #1

Ensure the patient is stable—most patients presenting with movement disorders have noticed changes over the course of months/years and are usually stable.

Step #2

Hx

Focus on the types of movements, onset, progression, medication review, infectious/sexual Hx, metabolic disorders, and Sx/risk factors associated with strokes and neoplasms. FHx should also be elicited.



Movement Disorders

Hyperkinetic

Dystonia - sustained muscle contractions causing twisting and repetitive movements or abnormal postures.

Chorea - irregular, unpredictable, brief, jerky movement, that flow randomly from one part of the body to another.

Myoclonus - sudden, brief, shock like involuntary movement cause by active muscle contraction (positive myoclonus) or inhibition of ongoing muscle contraction (negative myoclonus)

Ballismus - rapid, high amplitude, violent, flinging movements originating from proximal muscles.

Tremor - Rhythmic oscillation of a body part secondary to alternating or synchronous contraction of reciprocally innervated antagonistic muscles.

Tics - steroptypic/patterened movements/vocalizations accompanied by a pre-event urge.

Classification of Tremors
(based on when it is most prominent)

Rest
patient quietly resting
Ex: Parkinson disease

Action
During voluntary muscle movement
Ex: Cerebellar disease, MS

Postural
patient maintaining a posture against gravity
Ex: enhanced physiologic tremor, essential tremor

Hypokinetic

Parkinsonism – a syndrome characterized by Tremor (predominantly rest tremor)
Rigidity
Bradykinesia
Postural Instability
Classic gait – decreased initiation, bradykinetic, shuffling, stooped posture, decreased arm swing, festinations, en bloc turning

NOTE: Parkinsonism does not equal Parkinson Disease.
Beware Red Flags:
Symmetric symptoms
Early postural instability or falls
Impaired up gaze
Poor response to Sinemet (carbidopa-levodopa)

Figure 13.8. Classification of movement disorders.

Step #3

Physical Exam

Characterize the movement/lack of movements (see Figure 13.8). A full neurologic exam should be completed. Tone assessment and examination of gait are crucial. A thorough systemic exam looking for red flags (Kayser-Fleischer rings, abnormal skin hyperpigmentation, rashes, arthropathy, signs of thyroid disorders, etc.) should also be done.

Step #4

Localization and DDx

Localization is not as important in movement disorder assessments as in the other areas of neurology—as most movement disorders localize to the basal ganglia (can also localize to cerebellum, corticopontocerebellar fibers, red nucleus). However it is crucial to consider and rule out all possible etiologies (Table 13.5).

TAbLE 13.5 Investigations of movement disorders based on DDx

Differential Diagnosis	Investigations
Primary	Some primary disorders are diagnosed by exclusion, others by genetic testing. Consult neurology.
Secondary	
Metabolic—Wilson's, Vit B_{12} deficiency, Vit E deficiency, electrolyte abnormalities	Electrolytes, Ca^{2+}, Mg^{2+}, Cr, BUN, liver enzymes/function tests, serum ceruloplasmin, 24-h urine for copper, liver biopsy
Endocrine—thyroid D/O, HONK, DKA, chorea gravidarum	TSH, glucose
Structural—stroke tumor, abscess	Neuroimaging, LP
Infection/postinfectious—syphilis, Lyme (rare), Sydenham chorea	VDRL, HIV serology, Lyme serology
Immunologic—MS, SLE	ANA, ENA, McDonald criteria
Medications—Maxeran, anti-Parkinson drugs, antipsychotics, cocaine, amphetamines	Medication review

Step #5

Investigations

Depends on clinical suspicions (see Table 13.5)

Step #6/7

Dx/Management

The Dx and management of movement disorders are complex. As such only a few common disorders and their management will be covered here (Table 13.6).

TAbLE 13.6 • Management of select movement disorders

Diagnosis	Clinical Findings	Management
Hyperkinetic Movement Disorders		
Tremor Postural Essential Enhanced physiologic Intention/kinetic Midbrain stroke Cerebellar disease (MS, EtOH) Rest Parkinsonism (see below)	FmHx, postural/intention, better with EtOH FmHx, worse with EtOH, anxiety, fatigue, caffeine, etc. Acute onset, contralateral weakness, ipsilateral CN III palsy Associated ataxia	Trial of propranolol Caution patient to avoid excessive caffeine, EtOH, etc. Refer to neurologist for w/u and management

(Continued)

TABLE 13.6 • Continued

Diagnosis	Clinical Findings	Management
Chorea	FmHx, onset of sx (e.g. stroke), hx infxn/rheumatic fever, pregnancy.	R/O treatable secondary causes (e.g., Wilson's) Modify offending medications if necessary Refer to neurologist for further w/u and management Refer for genetic testing/ counseling
Dystonia	Involuntary twisting movements, alleviated by "sensory trick" (lightly touch affected body part)	
Ballismus	Flailing/flinging movements	
Myoclonus	Non-rhythmic, not suppressible, brief jerking movement	
Hypokinetic Movement Disorders		
Parkinson disease	Asymmetric rest tremor, rigidity, bradykinesia with no red flags that suggest Parkinson plus syndrome	Trial of L-Dopa Refer to neurologist if red flags present

CLINICAL box

Wilson Disease

Rare, deadly but treatable autosomal recessive disease of copper metabolism

Pathophysiology

Mutation in *ATP7B* on chromosome 13 → encodes for Cu transporting ATPase in liver → cannot incorporate Cu into ceruloplasmin and excrete it in bile → accumulation of copper in liver, brain, and other tissues.

Manifestations

- Liver (onset < 40 y.o.): cirrhosis → chronic active hepatitis → fulminant liver failure
- Brain (onset third decade): most common = dysarthria/dystonia/asymmetrical tremor
  - Early—ataxia, mask-like facies, personality changes
  - Late—dystonia, spasticity, other movement disorders, Sz, etc.
- MSK—arthropathy, osteopenia
- Heme—hemolytic anemia
- Renal—Fanconi syndrome, urolithiasis, hematuria, nephrocalcinosis
- Eye—Kayser-Fleischer rings

Investigations

Serum ceruloplasmin, 24-h urine for copper, slit lamp examination, neuroimaging, liver biopsy

Treatment

Diet modifications: avoid food high in copper (liver, chocolate, nuts, mushrooms, shellfish legumes, well water)

Chelation: zinc, trientine, penicillamine

GAIT DISTURBANCES

MCC OBJECTIVE

Based on Objective #35 (Ataxia [Gait]) of *Objectives for the Qualifying Examination,* 3rd edition.

OVERVIEW

Definitions

- **Gait**—the manner of walking. Normal mobilization requires the coordination of vision, vestibular function, cerebellar function, sensory perception, and motor capabilities. Patients are usually able to compensate with the loss of one modality (e.g., blind people are still able to walk); however, if more than one modality is affected, or certain ones are affected severely, an impaired gait may result.

- **Ataxia**—impaired ability to coordinate muscular movements (may be axial and/or appendicular muscles involved)

APPROACH

The overall goal is to identify the type of gait abnormality. This helps determine the affected modality (i.e., motor, sensory, cerebellar, vision, vestibular, etc.). From there, one needs to determine the etiology.

Step #1

Ensure the patient is stable.

Step #2

Hx

As always a full Hx should be obtained, however, important information to ascertain is the acuity of onset, progression, associated Sx, and falls or injuries as a result of the gait impairment.

Step #3

Physical Exam

A full neurologic exam should be conducted with concentration on vision, strength, sensation, and cerebellar function. Gait assessment includes comments on the patients' base, posture, stride height and length, initiation, arm swing, festinations (shortened strides as seen in Parkinsonian gait), turning, posturing, etc. If patients are diabetic, it is also important to conduct a full diabetic foot exam.

Step #4/5/6/7

Localization/Investigations/Dx/Management (Table 13.7)

TAbLE 13.7 • Workup and management of gait dysfunction based on localization

Localization	Diagnosis	Investigations	Management
Vision (decreased VA on exam ± impaired VF, EOM)	Cataracts, glaucoma, macular degeneration, VA decline, etc.	Formal ophthalmology assessment	Optometrist/ophthalmologist PT/OT assessment for mobility aids
Vestibular system (vertigo, N/V, nystagmus) Central vs. Peripheral	Vascular, tumor, abscess, demyelination, etc. BPPV, labyrinthitis, vestibular neuronitis, vestibular migraine	MRI Dix-Hallpike, Fukuda Stepping Test, etc.	Refer to neurologist for management (varies depending on etiology) Vestibular PT, Epley maneuver if applicable Alternatively, Symptomatic treatment (antiemetics, Serc, etc.)
Cerebellar system (ataxia)	Structural—vascular, tumor, abscess Toxins Inborn error of metabolism Degenerative	MRI EtOH Hx, tox screen Vit E, B_{12} Genetic testing	Refer to neurologist for w/u and management OT/PT
Motor system (weakness)	UMN—cortical, subcortical, brainstem, basal ganglia, spinal cord LMN—root, plexus, nerve, NMJ, muscle	See sections on Weakness and Movement Disorder (PD)	See sections on Weakness and Movement Disorder (PD)
Sensory system (decreased proprioception/joint position ± pain and temperature. Positive Romberg)	Cortical, subcortical, brainstem, spinal cord (involving posterior columns), radiculopathy, polyneuropathy, etc.	See section on Sensory Complaints	See section on Sensory Complaints

HEADACHE

MCC ObjECTIVE

Based on Objective #39 (Headache) of *Objectives for the Qualifying Examination,* 3rd edition.

OVERVIEW

Definition

Pain anywhere in the region of the head or neck. **Remember:** The brain does not have nociceptors and therefore does not feel pain (the dura mater, however, does).

APPLIED SCIENTIfIC CONCEPT (Figure 13.9)

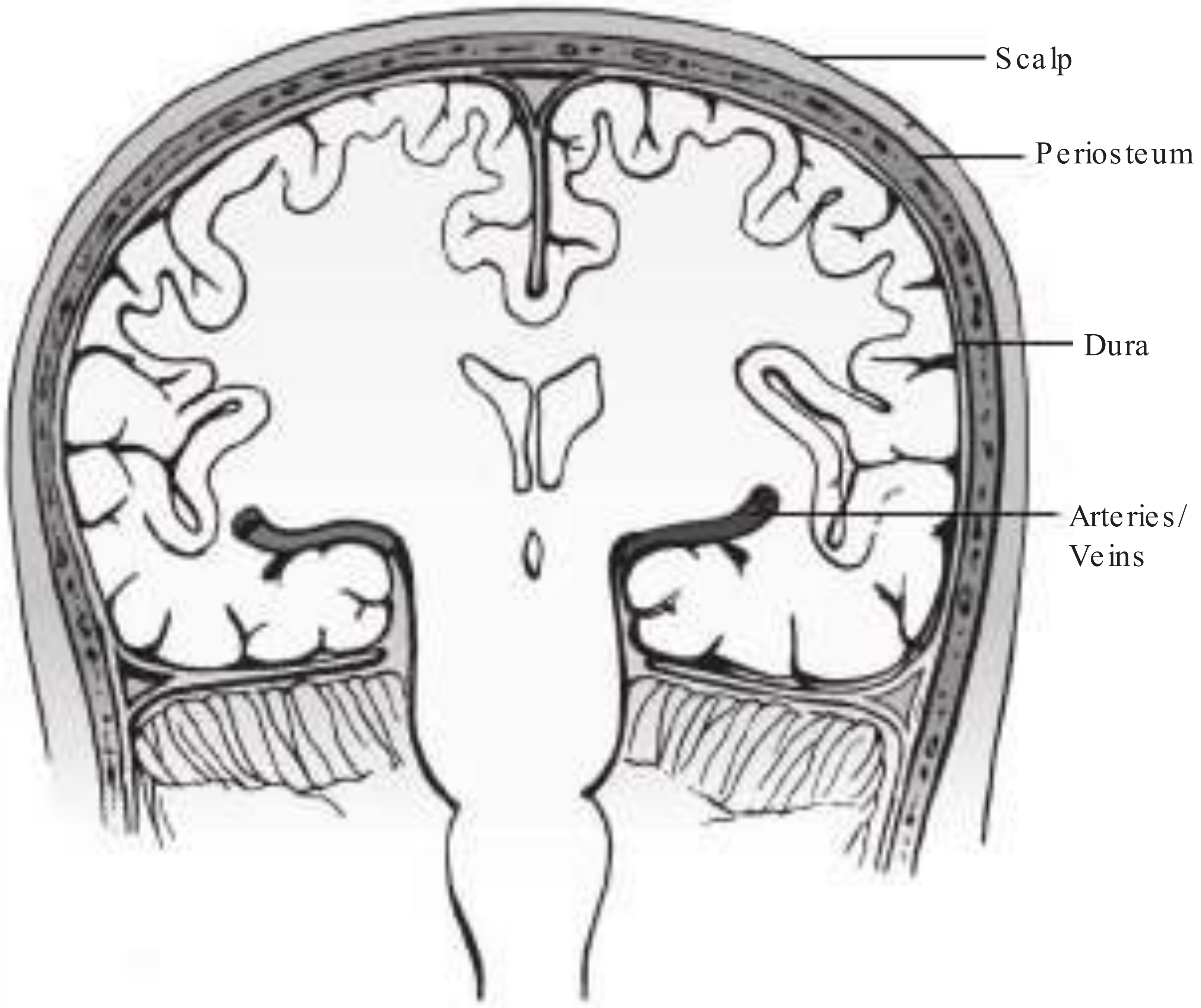


Figure 13.9. Cranial pain sensitive structures.

APPROACH

- Goal = identify red flags, R/O 2° causes, and investigate/treat accordingly

Step #1

Ensure the patient is stable! Many 2° cause of h/a need to be treated emergently (e.g., SAH, malignant HTN, meningitis, CO poisoning).

Step #2

Hx

Focus on characterizing h/a (OPQRST) and identifying red flags

Step #3

Physical Exam

Focus on identifying any focal neurologic signs, meningismus, papilledema, fever, severe HTN = red flags

Step #4

Localization and DDx

CLINICAL box

Red flags Suggestive of 2° h/a

First/different
Worst
Thunderclap Hx/acute
Persistent
> 50 y.o.
Worse in recumbency/with Valsalva
Worst in AM
Hx of trauma, cancer
Abnormality on neuro exam
Fever
Meningismus
Papilledema, retinal hemorrhages
Severe HTN
Hypercoagulable state/bleeding disorder
Taking anticoagulants
Pregnant
CO exposure
Jaw claudication/scalp tenderness/tenderness over TA/PMR/monocular blurred vision
Cocaine/amphetamine use
Must investigate!!

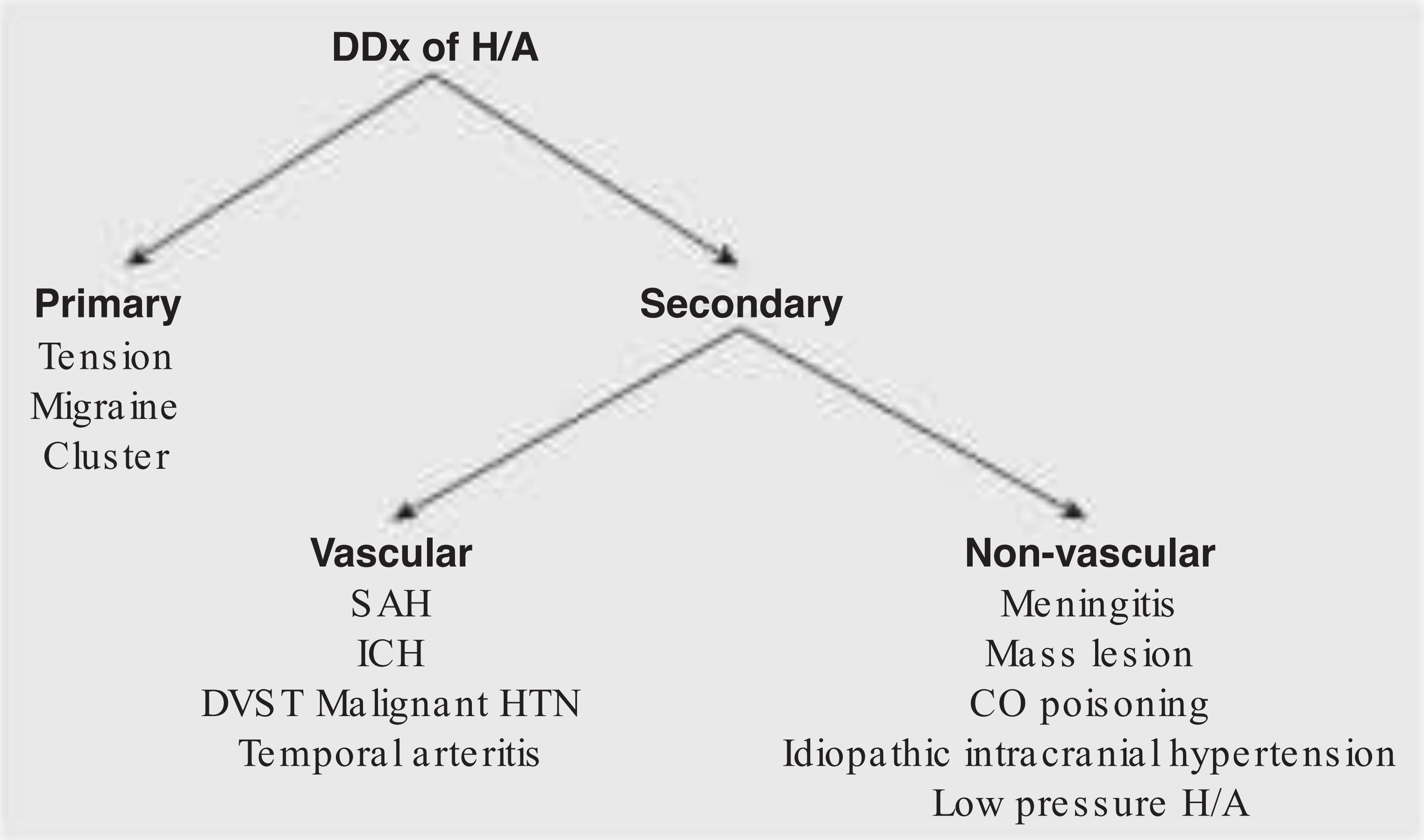


Figure 13.10. Classification of headaches.

CLINICAL box

The Dx of a 1° headache is made based on the clinical presentation. Investigations are only necessary when red flags are present.

Manager

Physicians are legally bound to perform appropriate clinical assessments on all patients presenting with h/a while ensuring the proper use of resources.

Step #5/6/7

Investigations, Dx, and Management (Tables 13.8 and 13.9)

TABLE 13.8 • Investigations and management of secondary headaches

Etiology	Clinical Features	Lab/Radiographic Features	Management
Vascular			
SAH	Thunderclap onset	CT: acute blood in subarachnoid space LP: high RBC + xanthochromia	Refer to NSx
Temporal arteritis	> 50 y.o., monocular blurred vision, tenderness over temporal artery, jaw claudication, scalp tenderness, PMR	Increased ESR Temporal artery biopsy	High-dose corticosteroids
Venous thrombosis	Diffuse h/a, Hx clots, OCP/HRT, hypercoagulable state, low flow state, dehydration, sepsis	MRV: thrombosis ± venous infarcts Abnormal hypercoagulable w/u[a] (INR/PTT/Pro C/Pro S/ATT/PG20210A/APCR/FVL/APLA)	Anticoagulation
Intracranial hematoma	Hx trauma, bleeding disorder Acute: rapidly progressive neurologic deficits Chronic: h/a may be only symptoms	CT: EDH, SDH, ICH, IVH	Refer to NSx
Severe arterial HTN	HTN, encephalopathic, papilledema, Hx cocaine, amphetamine, MAOI	Positive drug screen, urine metanephrines CT head: ±	Treat HTN Manage underlying conditions
Nonvascular			
Idiopathic intracranial hypertension (pseudotumor cerebri)	Worse in AM/recumbence/Valsalva, papilledema, worsening VA/VF	CT: no mass LP: high opening pressure	Diamox, Topamax, Lasix Ophtho/NSx consultation
Intracranial infection	Febrile, septic, meningismus, rash, encephalopathic, decreased LOC	LP (check opening pressure) Bacterial: increased protein, decreased glucose, increased WBC (polymorphs) Viral: increased protein, n-glucose, increased WBC (lymphocytes)	Antibiotics/antivirals
Mass lesion (abscess, tumor, etc.)	Gradually progressive h/a with focal neurologic findings	CT: ring-enhancing lesion	Refer to NSx

[a] INR, PTT; Deficiency of Protein C/S or Antithrombin; Prothrombin G20210A mutation; Factor V Leiden or APC resistance; Hyperhomocysteinemia; Antiphospholipid Antibodies

TABLE 13.9 • Diagnosis and management of primary headache conditions

	Clinical Features	Abortive	Prophylactic (. 8 d/mo, Sig Impairment, Contraindication to Abortive Rx)
Migraine	± Aura with mod-severe throbbing h/a, worse with activity, ± N/V, photo/phonophobia	NSAIDs, triptans, DHE	Propanolol, TCAs, AEDs, etc.
Tension type	Later in the day, no associated symptoms/signs. Mild-moderate, dull, aching, band-like h/a	NSAIDs, Tylenol	TCAs, AEDs
Cluster	M > F, severe, stabbing, unilateral/periorbital pain, with ipsilateral autonomic signs (tearing, miosis, hydrosis, conjunctival injection, etc.), seasonal recurrence of multiple episodes with intermittent remissions	O_2, triptans, DHE	Steroids (short-term), verapamil, methysergide, lithium
Medication overuse	Worsening chronic h/a. > 15 d/mo of OTC analgesia, and > 10 d/mo of triptans, ergots, combination analgesia	Drug holiday	

EPISODIC TRANSIENT IMPAIRMENT / LOSS OF CONSCIOUSNESS

MCC OBJECTIVE

Based on Objective #92 (Seizure/Epilepsy) of *Objectives for the Qualifying Examination,* 3rd edition.

OVERVIEW

Definitions

- **TLOC:** transient loss of awareness and/or responsiveness, caused by various mechanisms
- **Syncope:** TLOC caused by diminished blood flow and thus oxygen and glucose supply to the brain
- **Seizure:** a paroxysmal, abnormal, and synchronous discharge of cortical neurons, resulting in various semiologies
- **Epilepsy:** chronic condition characterized by two or more unprovoked seizures

Classification (Figure 13.11)

APPLIED SCIENTIFIC CONCEPT

- **Pathophysiology of seizure**—proposed mechanisms for the generation and spread of seizure activity within the brain include abnormalities in the membrane properties of neurons, changes in the ionic microenvironment surrounding the neuron, decreased inhibitory neurotransmission which is primarily by GABA, or enhanced excitatory neurotransmission which is primarily mediated by glutamate.

APPROACH

Main goal is to R/O status epilepticus and treat emergently. Then, differentiate between seizure and syncope. If seizure, then one must determine type and localization of seizure and whether it is provoked or not. This aids in management.

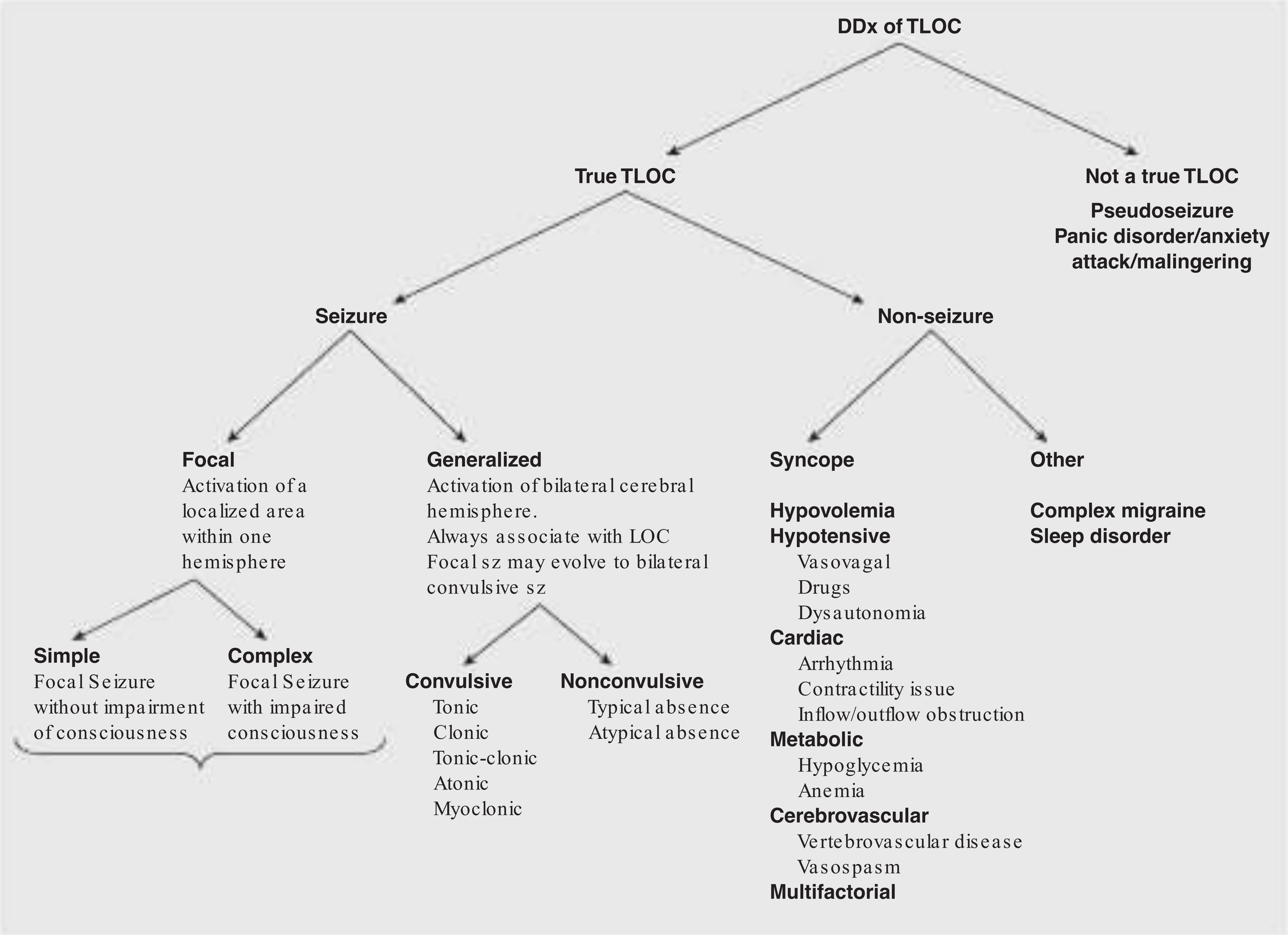


Figure 13.11. Classification of transient loss of consciousness.

Step #1

Ensure the patient is stable!

Status epilepticus is a common, life-threatening neurologic disorder characterized by one continuous seizure or recurrent seizures (without regaining consciousness between seizures) persisting for longer than 30 min. For clinical purposes, an operational definition of 5 min provides an appropriate time interval to initiate treatment for impending SE and prevent more prolonged or refractory SE. Because generalized tonic-clonic seizures usually last about 1 min, longer seizure activity implies failure of the physiologic factors that normally terminate seizures.

Step #2/3

Use your Hx and physical exam to differentiate between seizure and syncope, also ask about provoking factors (Table 13.10):

Hx (Step #2)

- Characterize preictal, ictal, and postictal event
- Assess RF for seizure/RF for syncope

Physical Exam (Step #3)

- Postural vitals, neurologic exam (focal signs and tongue biting), cardiac exam

Step #4

Localization and DDx

Sz localize to the cortex, but one must determine where in the cortex. One must ask themselves: **what type of seizure is this/what is the localization/what is the cause?**

CLINICAL box

Management of Status Epilepticus

- Step 1 (0–5 min)
  - Loosen patients clothing, lie on side, put bed rails up, etc.
  - Give oxygen. Assess airway and apply pulse oximeter. Test Chemstrip.
  - Perform venipuncture and secure IV access. Send blood work including AED level.
- Step 2 (6–10 min)
  - Administer thiamine and dextrose (unless normoglycemic)
  - 100-mg thiamine IV plus 50 mL of 50% dextrose IV
  - Give IV lorazepam at 0.1 mg/kg by IV push at a rate no greater than 2 mg/min. Repeat if seizures persist (If no IV access consider rectal diazepam).
- Step 3 (11–30 min)
  - Give IV phenytoin (20 mg/kg) by slow IV push no faster than 50 mg/min (Note: Phenytoin is incompatible with glucose-containing solutions.)
  - Monitor cardiac rhythm and blood pressure
  - If seizures persist, give additional phenytoin to a maximum total dose 30 mg/kg
  - Correct identified metabolic abnormalities
- Step 4 (31–50 min)
  - If seizures persist, patient will likely need to be intubated and given IV phenobarbital 20 mg/kg slow push (< 100 mg/min) or propofol to achieve burst suppression on EEG
- Step 5
  - Order urgent EEG, if necessary.
  - If seizures persist, maintain continuous IV infusion of phenobarbital

TABLE 13.10 • Differentiation of seizures from syncope

Seizure vs. Syncope					
	Hx				Physical
	Preictal	Ictal	Postictal	Other	
Seizure	Various auras: Psych (e.g., Déjà vu, olfactory, visual, epigastric sensation)	Tongue biting Urinary incontinence Bowel incontinence Automatisms Cyanosis Stereotypical movements Tonic Eyes open/deviated Can occur from any position	Confusion Focal neuro deficits (e.g., Todd paralysis)	PMHx: febrile seizure, head trauma, encephalitis, brain tumor (1° or 2°), EtOH, drug use, sleep deprivation	Bite marks on tongue Other injuries Focal neurologic deficits
Syncope	Prolonged standing Lightheadedness Diaphoresis Chest pain Palpitations Bradycardia Hypotension Tunnel vision	Flaccid Pallor Eyes closed Urinary incontinence possible Note: Convulsive syncope may mimic GTC Sz.	Resolution with recumbency	PMHx: cardiac Dz, DM as cause of dysautonomia or hypoglycemia New change in BP meds	Injuries Positive postural vitals Cardiac exam abnormalities

Seizure Classification/Localization

- Initial signs/Sx consistent with activation of a localized area within one hemisphere
  - **Motor**—various types of movement caused by activation of motor cortex
  - **Somatosensory**—somatosensory Sx (e.g., paresthesia) caused by activation of somatosensory cortex

    - **Special sensory**—olfactory, visual, etc. Sx caused by activation of various sensory cortices or association cortices
    - **Autonomic**—due to activation of central autonomic network or higher order autonomic control areas
- Initial signs/Sx consistent with (aura), later sign/Sx consistent with generalized seizure, associated with spread of cortical activation
- **Generalized—**initial signs/Sx consistent with activation of both cerebral hemispheres, always associated with a loss of consciousness
    - **Convulsive—**episode of abnormal muscle contraction, usually bilateral
        - **Myoclonic**—sudden, brief (< 100 ms), involuntary contraction of muscles
        - **Clonic**—prolonged, regular, repetitive movement, involving the same muscle groups, 2 to 3 Hz
        - **Tonic**—sustained muscle contraction lasting seconds to minutes
        - **Tonic-clonic**—tonic phase followed by clonic phase
        - **Atonic**—sudden loss of muscle tone lasting approximately 1 to 2 sec
    - **Nonconvulsive—**episode without abnormal muscle contraction
        - **Typical absence**—brief (sec) loss of consciousness without convulsions, with generalized 3 Hz spike and slow waves on EEG
        - **Atypical absence**—as above with abnormality of tone, 2 Hz spike and slow waves on EEG

Is the Seizure Provoked or Not (i.e., What is the Cause)

A provoked seizure is one caused by an underlying structural or systemic abnormality.

- Structural—congenital brain malformation, tumor, stroke, abscess
- Systemic—$Na^+/Ca^{2+}/Mg^{2+}$ abnormalities, uremia, hypo/hyperglycemia, hypo/hyperthyroid, EtOH/drug use, toxins

Step #5

Investigations

- **Blood work**–CBC, lytes, Ca^{2+}, Mg^{2+}, Cr, BUN, liver enzymes, TSH
    - **LP—**if suspicious of infection (large volume LP also useful for CNS lymphoma)
    - **Neuroimaging—**CT/MRI
    - **EEG**

Step #6/7

Dx and Management (Table 13.11)

AEDs affect voltage-gate Na^+ channels, GABA metabolism, Ca^{2+} currents, and a variety of other mechanisms *in vitro*. They work by similar complex mechanisms *in vivo*.

CLINICAL box

features Suggesting Pseudoseizure

Historical

Associated with Pscyh Dx, Hx of sexual/physical abuse, no Hx of injury from seizure, no response or worsening with AED, personal/family/professional experience with seizure

Clinical

Asynchronous limb movements, avoidance behavior, closed eyes, restricted eye opening, emotional/situational trigger, pelvic thrusting, head shaking, provoked by suggestion, seizures only occurring in presence of others, gradual onset/cessation, ictal crying, nonphysiologic progression, prolonged events

Investigations

Atypical seizure without electrical correlation on EEG, prolonged events without CK bump

CLINICAL box

Hints on Hx and O/E of Provoking Factor

- Hx—EtOH/drug use, CNS Infx Sx, known brain neoplasm, past strokes
- Physical exam—fever, focal neurologic findings, altered LOC

TAbLE 13.11 • Antiepileptic therapy

Drug	Mechanism	Uses	Notes
Valproate	Increases GABA	Generalized seizures (primary GTCSz, absence, myoclonus, etc.). Can also be used for partial/focal seizures.	S/E: GI upset, tremor, weight gain, hair loss, pancreatitis, liver dysfunction. Beware teratogenicity
Carbamazepine	Na^+ channel antagonist	Partial/focal onset seizures (worsens myoclonus)	S/E: GI upset, dizziness, sedation, rash, liver dysfunction, blood dyscrasia
Levetiracetam	Unknown	Generalized and focal seizures	Generally well tolerated, may increase rapidly if needed
Lamotrigine	Na^+ channel antagonist, decreases glutamate	Generalized and focal seizures	Generally well tolerated, need lot of time to titrate, beware SJS
Topiramate	Na^+/Ca^{2+} channel modulation causing decreased glutamate	Generalized and focal seizures	S/E: drowsiness, word finding difficulties, weight loss, digit paresthesias
Dilantin	Na^+ channel antagonist	Generalized and focal seizures (worsens myoclonus)	S/E: drowsiness, dizziness, ataxia, cerebellar degeneration, gum hyperplasia, OP. Good for loading patients in status epilepticus

Communicator

Reporting incomplete seizure control to the authorities may be an exception to the duty of confidentiality. This represents a legal requirement in some jurisdictions in the interest of public health, but physicians must recognize reasonable disclosure and reveal only necessary information to third parties.

Can MED

CLINICAL box

Safety Considerations

Driving—patients must be seizure free for a set time (jurisdiction specific).

Occupational—patients working in transportation or jobs with moving equipment/open flames/chemicals/at heights may need to consider a new career.

Leisure—isolation sports, swimming, and cycling may need to be modified.

Home—avoid baths, do not lock bathroom door, turn down hot water heater, cook with back burners, limit EtOH, avoid sleep deprivation, avoid heights, etc.

Women—those of childbearing age require contraception to avoid teratogenicity of AEDs.

ALTERED/IMPAIRED MENTAL STATUS

MCC ObjECTIVES

Based on Objectives #58-2 (Delirium) and #58-3 Major/Mild Neurocognitive Disorders (Dementia) of *Objectives for the Qualifying Examination,* 3rd edition.

OVERVIEW

Definitions

Mental Status

Composed of attention and arousal as well as cognition and executive function (comprising various processes such as language, memory, information processing, attention, problem solving, verbal reasoning, inhibition, mental flexibility, multitasking, etc.)

Classification of Altered Mental Status (Figure 13.12)

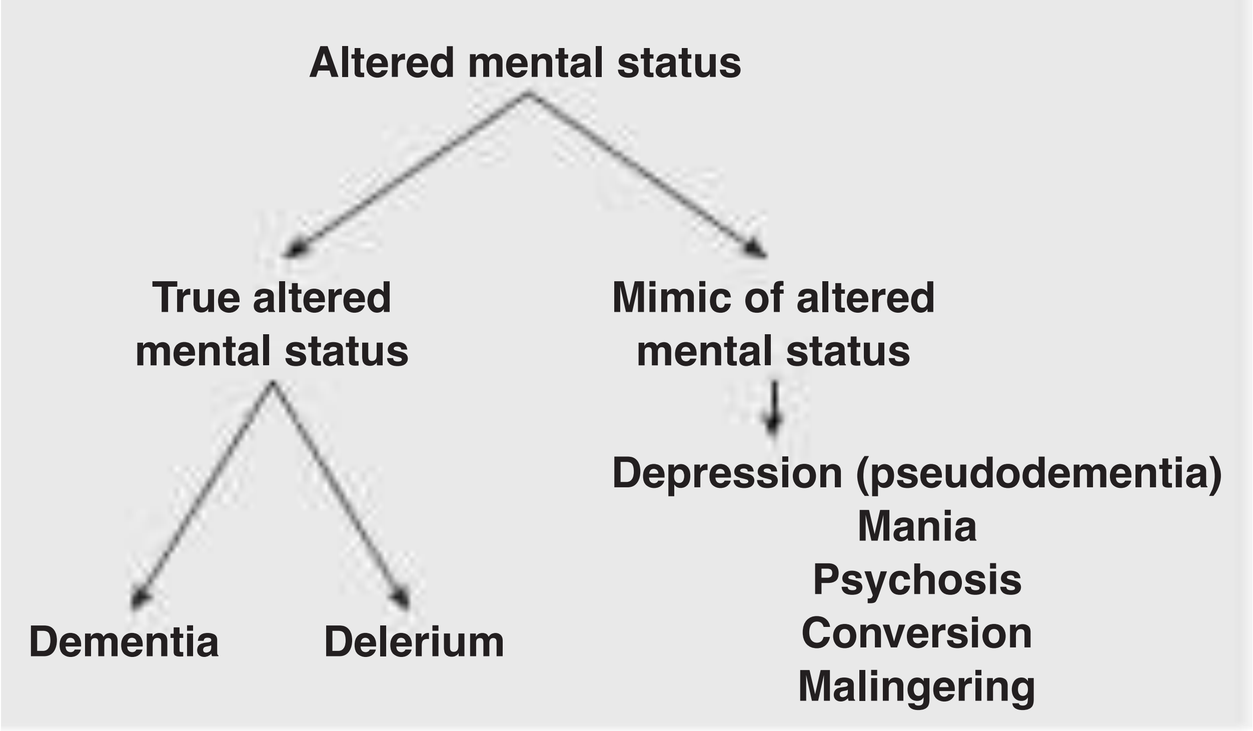

Altered mental status
True altered mental status
Mimic of altered mental status
Dementia
Delerium
Depression (pseudodementia)
Mania
Psychosis
Conversion
Malingering

Figure 13.12. Classification of altered mental status.

Dementia/Major Neurocognitive Disorder *(Adapted from DSM V)*

- Substantial cognitive decline from baseline in one or more cognitive
- Causing significant functional impairment
- Not caused by delirium or a psychiatric disorder

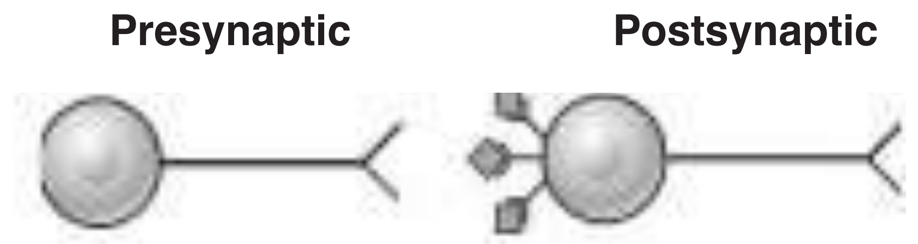
Mild Cognitive Impairment/Minor Neurocognitive Disorder *(Adapted from DSM V)*

- Modest cognitive decline from baseline in one or more cognitive
- Not sufficient enough to impair function
- Not caused by delirium or a psychiatric disorder

Delirium *(Adapted from DSM IV)*

Acute change from baseline in attention and arousal (as well as one or more cognitive domain) that tends to fluctuate. Evidence of organic cause such as a medical condition, substance intoxication/withdrawal, or toxin exposure.

APPLIED SCIENTIFIC CONCEPT (Figure 13.13)



↓ Acetylcholine production via:
- Hypoxia
- Hypoglycemia
- Thiamine deficiency

- Anticholinergic drugs worsen delerium

Observational evidence implicates Ach dysfunction in the pathophysiology of delerium

Figure 13.13. Acetylcholine in the pathophysiology of delirium.

APPROACH

The goal is to differentiate between dementia and delirium. No localization is necessary. However, one must remember that it is possible for demented patients to present with delirium and for the first presentation of dementia to look like delirium. Once the distinction has been made, the approach changes accordingly.

Step #1

Ensure the patient is stable

Step #2

Hx

Collateral Hx is crucial! Focus on onset and time line! Delirium is acute and fluctuates. Dementia is insidious and continuously progresses. Characterize what changes have been observed in mental status, personality, and function (ADL and IADLs). Also assess the patient's safety (e.g., leaving the stove on, wandering, not dressing appropriately for the weather).

Step #3

Physical Exam

A complete MMSE/MOCA exam should be completed as well as possible additional tests (usually done by OT). The remainder of the neurologic exam should be conducted to assess for any focal deficits. A full systemic exam should also be conducted.

Step #4

Localization

No anatomic localization is necessary unless one is possible.

Step #5/6/7

Investigations/Dx/Treatment (Table 13.12)

CLINICAL box

ADLs and IADLs

ADLs
- Dressing
- Eating
- Ambulating
- Toileting
- Hygiene

Instrumental ADLs
- Shopping
- Housekeeping
- Accounting
- Food preparation
- Taking medications
- Telephone usage
- Transportation

TABLE 13.12 • Workup and management of delirium and dementia

Delirium	Dementia
Investigations: Further Hx regarding possible etiologies—recent trauma, full ROS including infectious Sx, PMHx Not necessary, PSHx especially recent surgeries, medication review, SHx focusing on EtOH and drug use Review of physical exam—focal neuro deficits, systemic findings Labs—CBC-D, lytes/Ca^{2+}/Mg^{2+}/PO_4^{3-}, Cr/BUN, AST/ALT/Tbili/ALP/INR/PTT, CXR, Urine R&M/C&S, ± sputum/stool C&S, LP, ABG, EtOH/tox screen etc. Imaging—CT head Other—EEG	Labs—CBC, TSH, lytes, Ca^{2+}, glucose levels. Other investigations only as indicated. Neuroimaging—CT head is recommended if 1 or more of the following: < 60 y.o., rapid decline, recent/significant head trauma, focal unexplained neurologic symptoms or signs, Hx or cancer, use of oral anticoagulants or Hx of bleeding D/O, Hx of early urinary incontinence/gait disturbance. R/O reversible causes (10%–15%)

COMA

MCC OBJECTIVE

Based on Objective #58-1 (Coma) of *Objectives for the Qualifying Examination,* 3rd edition.

OVERVIEW

Definition

Coma

A pathologic state of unarousable unconsciousness. Coma is a Sx, not a Dx!

APPROACH

The first step is to convince yourself the patient is truly comatose. Beware of mimics, such as locked-in-syndrome (the patient is completely paralyzed, but alert and aware), akinetic mutism (the patient lacks the impulse to move), malingering, persistent vegetative state (occurs in patients who have barely emerged from coma, or have progressed into profound dementia), or brain death (discussed in the next section). Afterward the approach is very similar to the approach to delirium—through Hx, physical exam, and investigations, one must find the cause of the coma and then treat accordingly.

Step #1

Ensure the patient is stable—depending on the cause of the coma, these patients may be very unstable.

ABC, IV, O_2, monitors, STAT investigations (see below); consider administration of thiamine, glucose, and/or Narcan

CLINICAL box

Neurologic Examination of the Comatose Patient

CN—pupillary light reflex, oculocephalic reflex, vestibulo-ocular reflexes, corneal reflexes, gag reflex, cough reflex

Motor—tone and deep tendon reflexes, plantar reflexes

Step #2

Hx

Collateral Hx is crucial! Focus on preceding Sx, recent infection, surgery, trauma, PmHx, medication Hx, EtOH/drug Hx.

Step #3

Physical Exam

Examination of a comatose patient is daunting to many medical students and residents; however, once one has a firm grasp on the basic neurologic exam, examination of a comatose patients is easy—just do everything that does not require cooperation (see Clinical Box).

A full systemic exam is also imperative.

Step #4

Localization

No anatomic localization is necessary unless one is possible. However, determining if there is also a focal deficit may aid in determining what investigations to perform.

Step #5/6/7

Investigations/Dx/Treatment (Table 13.13)

TABLE 13.13 • Workup and management of coma

Localization	Suggested Pathology and Diagnoses	Investigations	Treatment
Focal	**Neurologic bilateral hemisphere or brainstem:** Hemorrhage Infarction Neoplasm Abscess Trauma Herniation	Neuroimaging—CT/MRI	**Vascular:** w/u cause of stroke and treat accordingly **Neoplasm:** consult NSx and/or oncologist **Abscess:** consult NSx + Abx **Trauma:** supportive care + consult NSx **Herniation:** Mannitol, HOB 30°, normocarbia/normothermic, consult NSx

(Continued)

TABLE 13.13 • Continued

Localization	Suggested Pathology and Diagnoses	Investigations	Treatment
Diffuse	**Systemic Deficiencies** Hypoxemia Hypercarbia Lytes deficiency Hypoglycemia Hypothermia Vit deficiency Hypothyroid (myxedema coma) **Excesses** Uremic Hepatic encephalitis Metabolic acidosis DKA/HONK Excess lytes Hyperthermia Thyroid storm Drugs/toxins	ABG, CBC-D, lytes, Ca^{2+}, Mg^{2+}, Cr, BUN, urinalysis, ALT, AST, PTT, INR, NH3, albumin, TSH, etc. ± CT head	Supportive care and correction of systemic abnormalities

HEAD TRAUMA

MCC OBJECTIVE

Based on Objective #109-10 (Head Trauma/Brain Death/Transplant Donations) of *Objectives for the Qualifying Examination,* 3rd edition.

OVERVIEW

Definitions

Concussion (Mild Traumatic Head Injury)

- Immediate and transient alteration of consciousness without macroscopic structural damage

GCS: EVM 4, 5, 6

- Eye opening (best):
  - 4—spontaneously
  - 3—to speech
  - 2—to pain
  - 1—none
- Best verbal:
  - 5—oriented
  - 4—confused
  - 3—inappropriate words
  - 2—incomprehensible sounds
  - 1—none
- Best motor:
  - 6—obeys
  - 5—localizes pain
  - 4—withdraws to pain
  - 3—flexion (decorticate)
  - 2—extension (decerebrate)
  - 1—none

Categorization of Head Injury Severity *(Postresuscitation GCS)*

- **Mild:** GCS 13 to 15 with brief LOC or impaired cognition
- **Moderate:** GCS 9 to 12 or LOC > 5 min
- **Severe:** GCS 3 to 8

APPLIED SCIENTIFIC CONCEPT

- 1° versus 2° brain injury:
  - Primary: direct result of initial trauma
  - Secondary: evolution of brain injury and/or 2° complications (hypoxia, hypotension, cerebral edema)
- Type of head injury:
  - Skull fracture
  - Focal: contusion, subdural hematoma, epidural hematoma, traumatic subarachnoid hemorrhage
  - Diffuse: spectrum from concussion to diffuse axonal injury
  - Penetrating
  - Blast
- CPP = MAP − ICP (normal CPP > 50 mm Hg; normal ICP < 20 mm Hg)

APPROACH

Step #1

Ensure the patient is stable—ABC: full spinal precautions (log roll with c-spine immobilization, consider intubation if GCS < 8, avoid hypoxia with supplemental O_2. Avoid hyperventilation unless sign of herniation (posturing, dilated, and unreactive pupil). Avoid hypotension/hypovolemia.

Step #2

Hx—AMPLE Hx

- Allergies, Medications, Past medical Hx, Last meal, Events leading up to trauma

Step #3

Physical Exam

ATLS 1° and 2° survey with focus on the following:

- Look for evidence of basal skull fracture (periorbital/retroauricular ecchymosis, CSF otorrhea/rhinorrhea, hemotympanum)
- Facial fractures: palpate for instability and step off deformity
- Focused neurologic exam:
  - CN
    - VA (Rosenbaum near vision card, if able to cooperate)
    - Fundoscopy
    - Pupil size and reaction to light
    - Extraocular movements (CN VI palsies common with increased ICP)
    - Facial nerve function
  - LOC: GCS
  - Motor exam

Step #4

Localization

Based on limited neurologic Hx and exam detailed above

Step #5

Investigation

Trauma blood work panel, CXR (portable), lateral C-spine XR ± pelvic XR. CT Head if GCS < 13 and according to CT head rule for minor traumatic head injury

Canadian CT Head Rule

Applicable only for adults with minor head injury who are not anticoagulated

- Order CT head if one of these criteria met:
  - High risk:
    - GCS < 15 at 2 h postinjury
    - Suspected open or depressed skull fracture
    - Any sign of basal skull fracture (periorbital/retroauricular ecchymosis, CSF rhinorrhea/otorrhea)
    - Vomiting 2 episodes
    - Age 65 yr
  - Medium risk
    - Amnesia for events 30 min prior to impact
    - Dangerous mechanism (pedestrian struck, ejection MVC, fall 3 ft/5 stairs)

Step #6/7

Dx/Treatment

Largely based on CT head findings

- Epidural hematoma: hyperdense biconvex extraaxial collection on CT that does not cross sutures. Typically arterial (middle meningeal artery). Classically but not commonly LOC at scene with lucid interval.
  - **Tx:** consult neurosurgery. EDH often require surgery especially if larger than 30 cc in volume.
- Subdural hematoma: crescentic hyperdense extraaxial collection crossing sutures most frequently along supratentorial convexity. Subacute (> 4 d old) and chronic (> 2 wk old) SDH will be isodense and hypodense to brain, respectively. Typically venous (bridging veins). Watch for uncal herniation (ipsilateral fixed and dilated pupil, contralateral hemiparesis, and declining level of consciousness).
  - **Tx:** Consult neurosurgery. Large SDH (> 1 cm) with > 5 mm midline shift may require surgical evacuation.
- Intraparenchymal hemorrhage/contusion: patchy ill-defined hyperdensity within brain parenchyma within edematous background characteristically in anteroinferior frontal or temporal lobes
  - **Tx:** Consult neurosurgery. Large hematomas (> 4 cm, near cortical surface, posterior fossa) may require surgical evacuation.
- Traumatic subarachnoid hemorrhage: hyperdense blood layer in sulci often adjacent to contusions or extraaxial hemorrhages. Typically *asymmetric* in contrast to aneurysmal SAH.
  - **Tx:** Consult neurosurgery. May require ICP pressure monitoring or drainage.
- Skull fractures: irregular hypodense lines that are thin and without branching (in contrast to vessels) and not typically along known sutures (e.g., coronal, sagittal sutures) seen best on bone-windowed CT
  - **Tx:** Consult neurosurgery. Depressed (> 1 cm) or open skull fractures may require surgery.

ICP management options (in consultation with neurosurgeon):

- Head of bed > 30 degrees (enhances venous outflow)
- Neutral neck, avoid neck compression
- Avoid hypotension
- Normal to mild hypocarbia (hyperventilation only for signs of herniation or as bridge to surgical treatment)
- Sedation (opioids, versed, propofol)
- Intracranial pressure monitoring (external ventricular drain, intraparenchymal monitor)
- Osmotics (mannitol 0.25–1 g/kg, rapid IV bolus, or hypertonic saline)
- Paralytics
- Surgical options (clot evacuation, decompressive craniectomy)

END OF LIFE IN THE NEUROLOGIC PATIENT

MCC OBJECTIVE

Based on Objective #109-10 (Head Trauma/Brain Death/Transplant Donations) of *Objectives for the Qualifying Examination,* 3rd edition.

OVERVIEW

Definitions

- **Brain death**—brain death is defined as the irreversible loss of function of the brain, including the brainstem.
- **Total compassionate care**—cessation of active medical management with care directed at comfort measures for patients who are anticipated to die imminently.

APPROACH

Given the complexity of end-of-life care in neurologic patients and the specific objectives listed by the LMCC, brain death and organ transplantation will only be focused on in this section. Determining brain death in patients is common in both neurology and neurosurgery. The process of determining brain death depends highly on the Hx and physical exam. Investigations are only utilized when uncertainty exists.

brain Death Criteria

- **Prerequisites** (i.e., the things that make you consider brain death as a possibility):
    - Evidence (whether clinical or via neuroimaging) of an acute CNS catastrophe that is compatible with the clinical Dx of brain death
    - No complicating factors such as severe electrolyte, acid–base, endocrine, or metabolic disturbances.
    - No drug intoxications or poisoning (One must allow ample time for drugs to leave the system.)
    - Normothermic
- **Requirements** (i.e., the things that confirm brain death has occurred):
    - Coma or unresponsiveness—no cerebral motor response to pain in *any* extremities (beware spinal reflexes)
    - Absence of brainstem reflexes
        - Pupils—fixed (no response to light) and dilated (4–9 mm)
        - Ocular movements
            - no no oculocephalic reflex ('doll's eyes')
            - no vestibulo-ocular reflex (R/O excessive cerumen in ear canal or perforated TM)
        - Facial movements
            - no corneal or nasal reflex
            - no grimacing on supra-orbital pressure
            - no jaw reflex
        - Pharyngeal movements
            - no gag
            - no cough
    - Positive apnea test—no Resp effort with ventilator off and a resultant increase of $\text{Paco}_2 > 60$ mm Hg or 20 mm Hg above baseline. As long as $\text{Po}_2 > 200$ mm Hg, SB > 90 mm Hg, normothermic, and euvolemic.

Communication

Chart documentation and appropriate communication with family members is key in end-of-life management.

Confirmatory Investigations

Recommended when not all clinical criteria can be met because of severe facial trauma, previous pupil abnormalities, toxins/drugs, OSA, or other chronic pulmonary diseases

- Conventional (catheter) angiography
- EEG
- Transcranial U/S
- Technetium-99m hexamethylpropylene amine oxime brain scan
- Somatosensory evoked potential

Organ Donation

There are two clinical situations in which organ donation may be pursued:

- Brain death—when a patient has been deemed brain dead, has no contraindications, and his or her family has consented, or he or she had previously gifted his or her organs.
- Donation after Cardiac Death (DCD)—in patients who do not meet criteria for brain death, but who are unlikely to make a meaningful recovery, if they have no contraindications and their family has consented, procurement of organs from a non-heart-beating donor may occur (this is relatively a new protocol, which entails preparing the patient for surgery). Once in the OR with the procurement team standing by, they are removed from life-support. Once their heart stops procurement commences.

Regional transplant centers have different sets of absolute and relative criteria for excluding potential organ donors, but in general absolute contraindications include:

- Age older than 80 yr
- HIV infection (HBV and HCV are only relative contraindications.)
- Active metastatic cancer
- Prolonged hypotension or hypothermia

Collaborator/Communicator/Manager

Organization of organ procurement and receipt is complex, and involves extensive communication and collaboration among multiple physicians in multiple centers. Management of health resources is also crucial.

- Disseminated intravascular coagulation
- Sickle cell anemia or other hemoglobinopathy
- Note: Sepsis is not a contraindication to organ donation.

Once a patient has been deemed a suitable donor and proper consent has been obtained, the regional organ donation organization must be notified. The patient then undergoes extensive evaluation of his or her blood type, HIV/syphilis/Hep BC status, organ function, etc. Once investigations are completed and there are no contraindications, procurement occurs.

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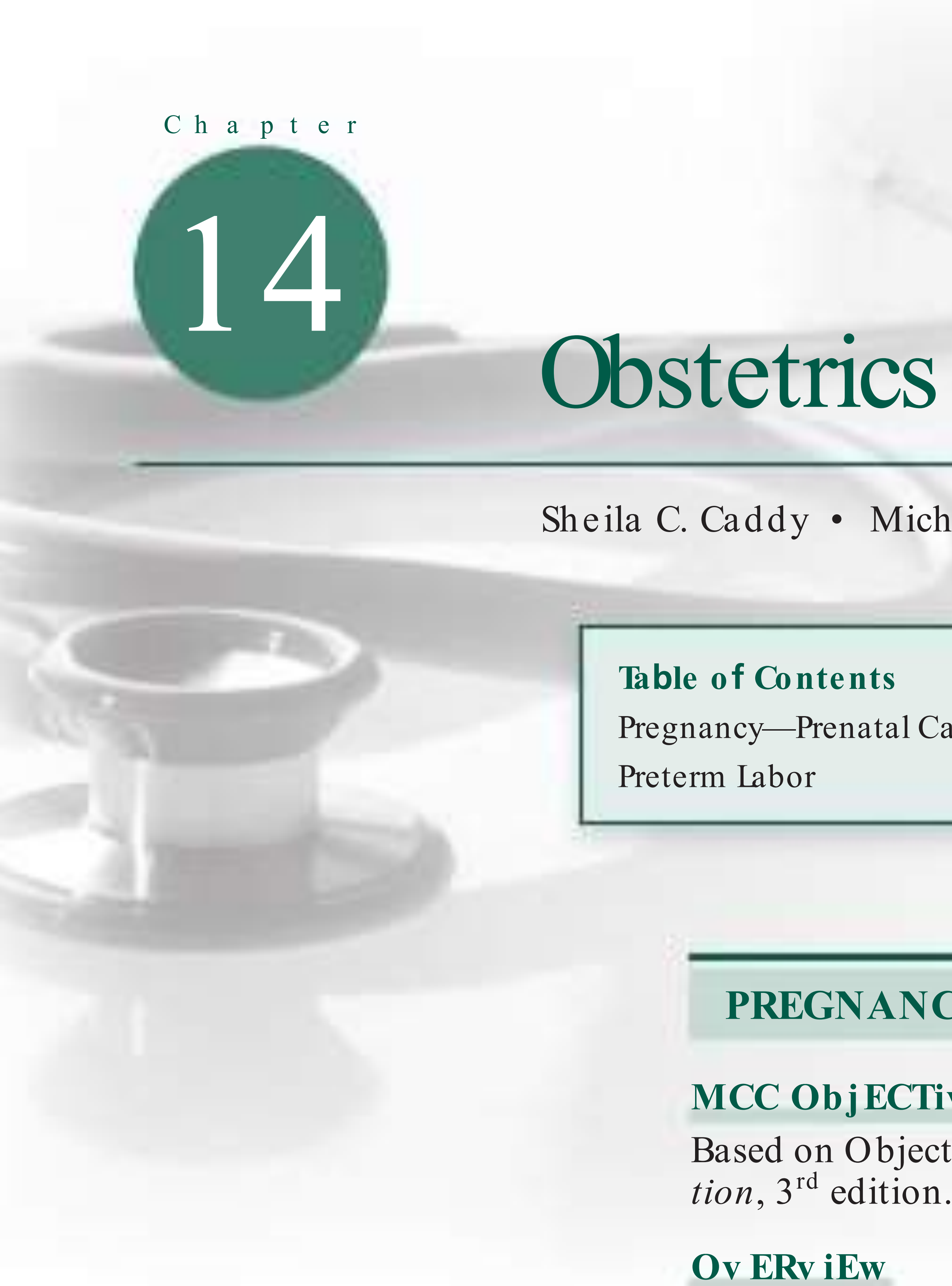


Chapter

14

Obstetrics

Sheila C. Caddy • Michael W. H. Suen

Table of Contents

Pregnancy—Prenatal Care
Preterm Labor
Pregnancy—Intrapartum Care
Pregnancy—Postpartum Care

PREGNANCY—PRENATAL CARE

MCC OBJECTIVE

Based on Objective #80-1 (Prenatal Care) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

The purpose of **antepartum care** is to help achieve as good a maternal and infant outcome as possible.

- Goals of antepartum care:
  - Ongoing risk assessment
  - Define health status of mother and fetus
  - Promote healthy behavior through lifestyle modification and screening
- Both psychosocial issues and biologic issues need to be addressed.
- Antepartum care helps to ↓ prenatal and maternal mortality rates.
- Virtually any maternal medical or surgical condition can complicate the course of a pregnancy and/or be affected by the pregnancy.
- Conditions arising in pregnancy can have adverse effects on the mother and/or the fetus. For example, babies born prematurely account for > 50% of perinatal morbidity and mortality.

APPLIED SCIENTIFIC CONCEPT (Table 14.1)

TABLE 14.1 • Physiological Δs associated with pregnancy

Organ System	Physiological Δ
CV	• Hyperdynamic circulation → ↑ CO, ↑ HR, ↑ SV • ↓ Mean arterial BP (lowest at 24 wk) • ↓ PVR due to vasodilation • ↓ Venous return and ↑ venous pressure due to compression of IVC + pelvic veins by uterus (e.g. supine hypotensive syndrome)
Hematologic	• Hemodilution (↑↑ plasma volume relative to ↑ RBCs) → apparent ↓ Hgb and Hct • ↑ WBC but ↓ function leads to improvement of AI disease • ↓ # Platelets → gestational thrombocytopenia • Hypercoagulable state → ↑ risk DVT, PE

TAbLE 14.1 • Continued

Organ System	Physiological D
Respiratory	• Level of diaphragm rises and ↑ subcostal angle • ↑ O_2 requirements • ↓ TLC, FRC, RV • Increase minute ventilation • RR stays the same
Breasts (preparation for lactation support)	• Breast tenderness, tingling (Progesterone induced) • ↑ Breast size, enlargement of nipples • ↑ Vascularity/blood flow to breast • ↑ Cuboidal alveolar cell and ductal (Estrogen induced) • ↑ Synthesis of milk components—casein, lactalbumin, fatty acids (R/PRL induced) • Initiation of secretory activity due to PRL and human placental lactogen (expression of colostrum [thick glossy, protein-rich fluid]) from 2nd trimester onward + first 30 h after delivery • Inhibition of full lactation high E/P levels
Skin	• ↑ Pigmentation (areola; cholasma - under eyes; linea nigra - anterior abdo wall) → due to ↑ secretion of melanocyte-stimulating hormone • Stretch marks—striae gravidarum (abdo wall, lateral thighs, breasts) → due to ↑ glucocorticoids
GI	• ↓ Tone and motility of stomach, small/large intestines → constipation • ↑ GERD Sx due to ↑ intra-abdo pressure and ↓ lower esophageal sphincter tone • ↑ Gallstones • Hemorrhoids • N/V - morning sickness in up to 70%; cause unclear
Renal	• ↑ GFR, (↑ renal blood flow) • ↑ Urinary frequency • ↑ UTI risk due to ↑ urine stasis + ↑ glucose content of urine • ↓ Bladder tone, ↑ ureter and renal pelvis dilation (P induced smooth muscle relaxation)
Endocrine	• ↑ Size and vascularity of pituitary, thyroid glands • ↑ PRL, oxytocin, ↑ ACTH, ↑ GC secretion vs. normal TSH, ↑ thyroid hormones, ↑ BMR • Suppressed GH but replaced by hPL
Uterine (D size, shape, consistency + position)	• ↑ Size uterine fundus through hypertrophy of stroma • D from pear shape to globular, eventually becoming spherical by the end of 1st trimester; begins to assume an ovoid shape starting in 2nd trimester; 2nd and 3rd trimester → expansion of uterine cavity from 4 mL in nonpregnant state to up to 5L at full term • Hypertrophy of blood vessels supplying uterus → dilation of arteries, ↑ blood flow

APPROACh

Key objectives:

- Develop an appropriate relationship and rapport
- Counsel about pregnancy before conception, if possible
- Determine whether the pt is pregnant and estimate the date of confinement—EDC
- Educate the pt regarding physiologic Ds associated with pregnancy
- Arrange for initial investigations and appropriate investigations throughout pregnancy
- Arrange regular follow-up and screening for complications of pregnancy at each office visit

History (Figure 14.1)

- Establish the desirability of pregnancy, gestational age, current symptoms, and obstetrical Hx
- Screen for possible risks or complications of pregnancy due to gynecologic Hx, PMHx, surgical Hx, FHx, medications, allergies, and social Hx

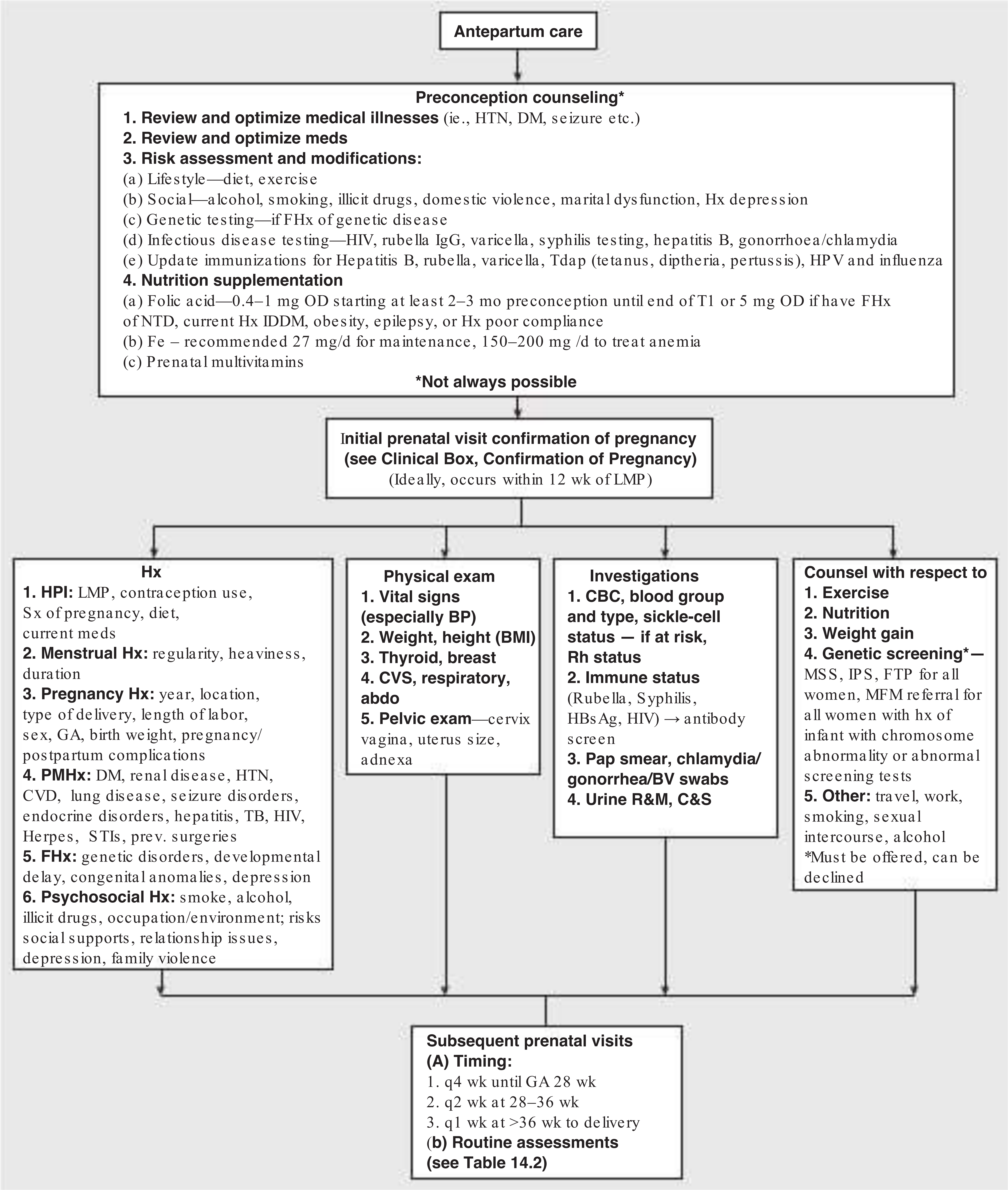

Antepartum care
Preconception counseling*
1. Review and optimize medical illnesses (ie., HTN, DM, seizure etc.)
2. Review and optimize meds
3. Risk assessment and modifications:
(a) Lifestyle—diet, exercise
(b) Social—alcohol, smoking, illicit drugs, domestic violence, marital dysfunction, Hx depression
(c) Genetic testing—if FHx of genetic disease
(d) Infectious disease testing—HIV, rubella IgG, varicella, syphilis testing, hepatitis B, gonorrhoea/chlamydia
(e) Update immunizations for Hepatitis B, rubella, varicella, Tdap (tetanus, diptheria, pertussis), HPV and influenza
4. Nutrition supplementation
(a) Folic acid—0.4–1 mg OD starting at least 2–3 mo preconception until end of T1 or 5 mg OD if have FHx of NTD, current Hx IDDM, obesity, epilepsy, or Hx poor compliance
(b) Fe – recommended 27 mg/d for maintenance, 150–200 mg /d to treat anemia
(c) Prenatal multivitamins
*Not always possible
Initial prenatal visit confirmation of pregnancy (see Clinical Box, Confirmation of Pregnancy)
(Ideally, occurs within 12 wk of LMP)
Hx
1. HPI: LMP, contraception use, Sx of pregnancy, diet, current meds
2. Menstrual Hx: regularity, heaviness, duration
3. Pregnancy Hx: year, location, type of delivery, length of labor, sex, GA, birth weight, pregnancy/postpartum complications
4. PMHx: DM, renal disease, HTN, CVD, lung disease, seizure disorders, endocrine disorders, hepatitis, TB, HIV, Herpes, STIs, prev. surgeries
5. FHx: genetic disorders, developmental delay, congenital anomalies, depression
6. Psychosocial Hx: smoke, alcohol, illicit drugs, occupation/environment; risks social supports, relationship issues, depression, family violence
Physical exam
1. Vital signs (especially BP)
2. Weight, height (BMI)
3. Thyroid, breast
4. CVS, respiratory, abdo
5. Pelvic exam—cervix vagina, uterus size, adnexa
Investigations
1. CBC, blood group and type, sickle-cell status — if at risk, Rh status
2. Immune status (Rubella, Syphilis, HBsAg, HIV) → antibody screen
3. Pap smear, chlamydia/gonorrhea/BV swabs
4. Urine R&M, C&S
Counsel with respect to
1. Exercise
2. Nutrition
3. Weight gain
4. Genetic screening*— MSS, IPS, FTP for all women, MFM referral for all women with hx of infant with chromosome abnormality or abnormal screening tests
5. Other: travel, work, smoking, sexual intercourse, alcohol
*Must be offered, can be declined
Subsequent prenatal visits
(A) Timing:
1. q4 wk until GA 28 wk
2. q2 wk at 28–36 wk
3. q1 wk at >36 wk to delivery
(b) Routine assessments (see Table 14.2)

Figure 14.1. Approach to antepartum care.

- At every follow-up visit, determine current progress of pregnancy, vaginal bleeding or leaking of fluid, presence of fetal movements, and presence of contractions

Physical Exam

- Perform a full physical exam, including Pap test if indicated, at the first prenatal visit
- At each prenatal visit, a focused physical exam should be performed to assess for normal development of pregnancy and screen for complications of pregnancy (Table 14.2)

TAbLE 14.2 • Routine antenatal assessments according to GA

GA (wk)	Antenatal Routines
8–12	• Dating U/S → measure of crown-rump length; margin of error ± 5 d
10–12	• CVS
11–14	• FTS → measures (a) NTUS, (b) b-hCG, + (c) PAPP-A; provides risk estimate for trisomy 21. If + = CVS or amniocentesis should be offered • IPS part 1 (NTUS + PAPP-A)
11–13 + 6	• NTUS → measures AFV behind neck of fetus; early screen for congenital anomalies, i.e., trisomy 21 measures "thickness of neck" • Should only be used alone for twin pregnancy estimation of T21 risk • Singleton pregnancy should have FTS, IPS, or QUAD screen
15–18	• IPS part 2 MSS markers (e.g. QUAD screen))
15–20	• QUAD screen (screen for trisomy 21, 18, and open NTDs) → measures (a) MSAFP, (b) b-hCG, + (c) unconjugated E (E3/estriol) + (d) inhibin-A • Amniocentesis if indicated
18–22 to term	• FMs (quickening)
18–22	• U/S for (a) anatomy and growth of fetus; margin of error ± 7 d; (b) placental position; (c) AFV (Note: In obese women, U/S should be delayed until 21–22 wk GA)

24–28	• Screen for gestational diabetes (GDM)—50 g oral glucose tolerance test (OGTT)
	  • Plasma glucose < 7.8 mmol/L → normal
	  • Plasma glucose > 7.8 to < 10.3 mmol/L(50 g OGTT) → do 2 h 75 g OGTT
	  • Plasma glucose > 10.3 (50 g OGTT) → GDM
	• Dx of IGT and/or GDM (Note: Both of these should be treated as GDM with increased surveillance, glucose monitoring, and referral.)
	  • 1–2 h 75 g OGTT: 1 AbN = IGT and 2+ AbN = GDM
	  • Fasting plasma glucose > 5.3 mmol/L
	  • 1 h plasma glucose (75 g OGTT) > 10.6 mmol/L
	  • 2 h plasma glucose (75 g OGTT) > 8.9 mmol/L

28	• Repeat CBC (Hg, Hct) • Check Rh—antibody titers • RhoGAM (RhIgG) for all Rh^- women (see Intrapartum Care topic)
35–37	• Vaginal and anorectal culture for GBS

(Continued)

CLINICAL box

Standardized Perinatal Forms

Most provinces have standardized perinatal forms that improve.

CLINICAL box

Signs and Sx of Pregnancy

Appear once hCG has reached sufficient levels approximately 3 to 4 wk postconception:

Sx

1. Amenorrhea
2. Nausea/vomiting
3. ↑ Urinary frequency
4. ↑ Fatigue/lassitude
5. Breast tenderness/heaviness
6. Constipation
7. Lower abdo cramps
8. Backaches/headaches

Signs

1. Uterine enlargement
2. Chadwick sign—blue cervix/vagina at 6 wk
3. Goodell sign—soft cervix at 4 to 6 wk
4. Hegar sign—soft uterine isthmus at 6 to 8 wk

CLINICAL box

GTPAL

Gravida (G)

G = total # pregnancies (current, abortions, miscarriages, ectopic)

Parity (TPAL)

T = # term births delivered (37–40 + wk)

P = # premature births delivered (20–36 wk)

A = # abortions (induced or spontaneous loss of intrauterine pregnancy before fetus viability—< 20 wk + < 500 g)

L = # living children

TAbLE 14.2 • Continued

Every visit	• Hx: estimate GA, Hx of present pregnancy, vaginal bleeding/leaking, abdo cramping • Weight of mother—expect steady increase (target weight gain depends on prepregnancy BMI) • Maternal BP (normal < 140/90 mm Hg) • FHR using Doppler U/S (normal = 110–160 bpm) • FMs—noticed by 18–20 wk in primigravida vs. potentially earlier in multigravida • Leopold maneuvers for lie, position, and presentation of the fetus (especially important toward the end of 3rd trimester for delivery) • Size of uterus SFH: at 12 wk—symphysis, 20 wk—umbilicus, 36 wk—xiphoid process • Urine glucose and protein (diabetes, kidney disease) • Additional U/S done if medically indicated

CVS = chorionic villus sampling; FTS = first trimester screening; NTUS = nuchal translucency u/s; PAPP-A = pregnancy-associated plasma protein a; IPS = integrated prenatal screening; AFV = amniotic fluid volume; MSS = maternal serum screen; NTD = neural tube defects; MSAFP = maternal serum alpha-fetoprotein; FMs = fetal movements; IGT = impaired glucose tolerance; SFH = symphysial fundal height

CLINICAL box

Estimating Date of Confinement

EDC

- First day of LMP
- Remember to determine length of cycle (28 d vs. 32 d)
- Naegele's rule = (LMP + 7 d) − 3 mo (for 28-d menstrual cycle)
- Date of conception
- Date of positive pregnancy test
- U/S findings
- Size of uterus (SFH)—12 wk at symphysis, 20 wk at umbilicus

Factors That Can D EDC

- Hx of irregular menstrual cycle
- Unknown LMP
- Use of OCP at time of conception

CLINICAL box

Leopold Maneuvers

A series of four abdo palpitations of the gravid uterus used to determine fetal lie, presentation, and position:

- First maneuver determines what part of the fetus occupies the fundus.
  - Head = round, hard, and ballotable versus buttocks = irregular
- Second maneuver determines which side the fetal back lies on.
  - Spine = long, linear, and firm versus extremities = multiple mobile small parts
- Third maneuver determines the presenting part of the fetus.
  - Vertex (head) = round, firm ballotable versus breech (sacrum) = irregular and nodular
- Fourth maneuver determines the position of the fetal head (if the infant is in vertex position) by palpating the cephalic prominence.
  - Flexed = brow is most prominent on the opposite side from the fetal back
  - Extended = occiput is most prominent and felt on same side as spine

Investigations

The appropriate investigations during pregnancy depend on gestational age and clinical status.

- Confirmation of pregnancy can be performed by urine or serum b-hCG, and location of pregnancy can be confirmed by transvaginal or transabdominal U/S.

CLINICAL box

Confirmation of Pregnancy

b-hCG

Peptide hormone produced by trophoblast cells; maintains the CL during pregnancy

Detected in serum 10 d and urine 10 to 14 d postconception

Serum b-hCG concentration is approximately 10 IU at time of missed menses, 100,000 IU at 10 wk, and 10,000 IU at term

Transvaginal U/S

Visible gestational sac at 5 wk (b-hCG > 1,500–3,000 IU), fetal pole at 6 wk, and fetal heart beat by 6 to 7 wk

Transabdominal U/S

Intrauterine pregnancy visible by 6 to 8 wk (hCG > 6,500 IU)

- Routine investigations according to GA are summarized in Table 14.2.
- Every pt should be **offered**, regardless of age or Hx, the option for prenatal Dx.

CLINICAL box

Types of Prenatal Screening Tests

- FTS = measures NTUS + PAPP-A + b-hCG
  - Estimates the risk for trisomy 21; approximately 85% sensitivity when combined with age
- QUAD = measures MSAFP + b-hCG + unconjugated E + inhibin A
  - Estimates the risk for NTD, trisomy 21 and 18
    - NTD → ↑ MSAFP approximately 80% to 90% sensitivity
    - Trisomy 21 → ↓ MSAFP, ↑ b-hCG, ↓ unconjugated E3, ↑ inhibin A approximately 77% detection rate
    - Trisomy 18 → ↓ MSAFP, ↓ b-hCG, ↓ unconjugated E3, ↓ inhibin A approximately 75% detection rate
- IPS = combines QUAD screen markers + NTUS + PAPP-A
  - Estimates the risk for trisomy 21, 18, and NTD

C_2 L E O

Patient Rights

- All pts have the right to be educated about their options for management of the pregnancy (continuation, termination, and adoption) as well as their options for genetic screening during the pregnancy.
- All counseling should be nondirective as each woman/couple has individual beliefs and motivations influencing their choices.
- Consideration of termination is not required to move forward with prenatal Dx as some women/couples chose testing in order to be prepared for any complications in the pregnancy.

CLINICAL box

Management of Positive Genetic Screen in Pregnancy

- All women should be notified and have the result explained to them in clear language.
- All women should be referred to the regional tertiary center for genetic counseling, a detailed U/S, and review of management options.
- Women should be notified of the referral and that they may be offered further testing in the form of either a CVS or amniocentesis. They should be reassured that they are under no obligation to undergo further invasive testing simply by attending this appointment. However, many women/couples find it helpful to go to the appointment to obtain further information.
- All referrals and review of results should be done on an urgent basis as management options are time sensitive.

CLINICAL box

Indications for Prenatal Dx

1. Abnormal U/S
2. Abnormal prenatal screen
3. PMHx or FHx genetic disease, chromosomal anomalies, recurrent pregnancy loss, consanguinity

Types

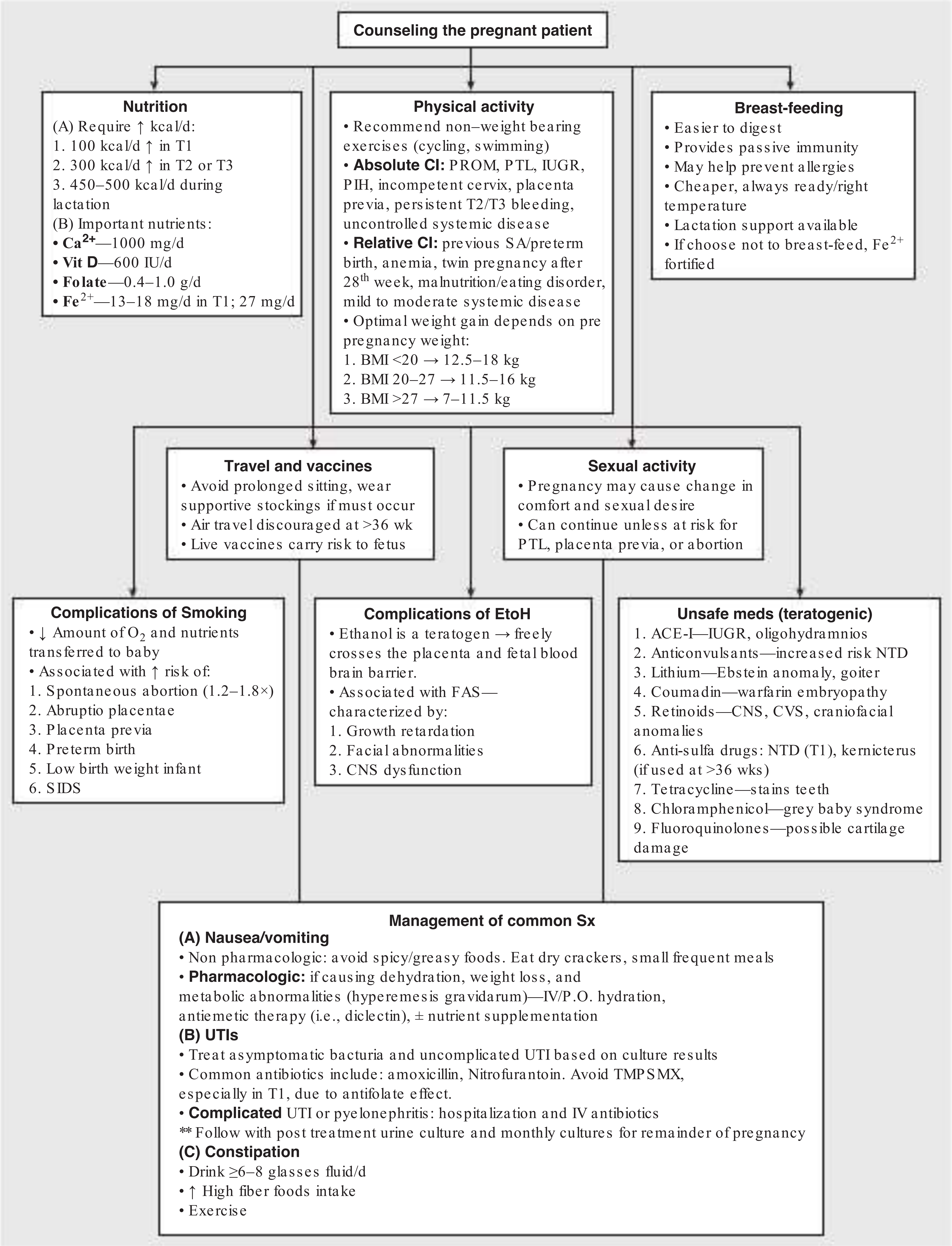
1. CVS = biopsy of placental tissue
2. Amniocentesis = U/S-guided transabdominal extraction of amniotic fluid

C_2 L E O

Immunizations in Pregnancy

- Provide all women who wish to become pregnant with clinically indicated immunizations, at least 3 mo before conception
- If at high risk for hepatitis A or pneumococcal infection, should be immunized
- Vaccines may be given during pregnancy if:
  - Have ↑ risk exposure to infection
  - Infection is hazardous to mother or fetus
  - Immunizing agent not likely to cause harm
- Inactivated virus vaccines, toxoids, and immune globulin = safe in pregnancy → delay administration until T2
- Influenza vaccines are recommended for all pregnant women and are safe during pregnancy

Management (Figure 14.2)



Counseling the pregnant patient

Nutrition

(A) Require ↑ kcal/d:
1. 100 kcal/d ↑ in T1
2. 300 kcal/d ↑ in T2 or T3
3. 450–500 kcal/d during lactation

(B) Important nutrients:
- **Ca^{2+}**—1000 mg/d
- **Vit D**—600 IU/d
- **Folate**—0.4–1.0 g/d
- **Fe^{2+}**—13–18 mg/d in T1; 27 mg/d

Physical activity

- Recommend non–weight bearing exercises (cycling, swimming)
- **Absolute CI:** PROM, PTL, IUGR, PIH, incompetent cervix, placenta previa, persistent T2/T3 bleeding, uncontrolled systemic disease
- **Relative CI:** previous SA/preterm birth, anemia, twin pregnancy after 28th week, malnutrition/eating disorder, mild to moderate systemic disease
- Optimal weight gain depends on pre pregnancy weight:
  1. BMI <20 → 12.5–18 kg
  2. BMI 20–27 → 11.5–16 kg
  3. BMI >27 → 7–11.5 kg

Breast-feeding

- Easier to digest
- Provides passive immunity
- May help prevent allergies
- Cheaper, always ready/right temperature
- Lactation support available
- If choose not to breast-feed, Fe^{2+} fortified

Travel and vaccines

- Avoid prolonged sitting, wear supportive stockings if must occur
- Air travel discouraged at >36 wk
- Live vaccines carry risk to fetus

Sexual activity

- Pregnancy may cause change in comfort and sexual desire
- Can continue unless at risk for PTL, placenta previa, or abortion

Complications of Smoking

- ↓ Amount of O_2 and nutrients transferred to baby
- Associated with ↑ risk of:
  1. Spontaneous abortion (1.2–1.8×)
  2. Abruptio placentae
  3. Placenta previa
  4. Preterm birth
  5. Low birth weight infant
  6. SIDS

Complications of EtoH

- Ethanol is a teratogen → freely crosses the placenta and fetal blood brain barrier.
- Associated with FAS—characterized by:
  1. Growth retardation
  2. Facial abnormalities
  3. CNS dysfunction

Unsafe meds (teratogenic)

1. ACE-I—IUGR, oligohydramnios
2. Anticonvulsants—increased risk NTD
3. Lithium—Ebstein anomaly, goiter
4. Coumadin—warfarin embryopathy
5. Retinoids—CNS, CVS, craniofacial anomalies
6. Anti-sulfa drugs: NTD (T1), kernicterus (if used at >36 wks)
7. Tetracycline—stains teeth
8. Chloramphenicol—grey baby syndrome
9. Fluoroquinolones—possible cartilage damage

Management of common Sx

(A) Nausea/vomiting
- Non pharmacologic: avoid spicy/greasy foods. Eat dry crackers, small frequent meals
- **Pharmacologic:** if causing dehydration, weight loss, and metabolic abnormalities (hyperemesis gravidarum)—IV/P.O. hydration, antiemetic therapy (i.e., diclectin), ± nutrient supplementation

(B) UTIs
- Treat asymptomatic bacturia and uncomplicated UTI based on culture results
- Common antibiotics include: amoxicillin, Nitrofurantoin. Avoid TMPSMX, especially in T1, due to antifolate effect.
- **Complicated** UTI or pyelonephritis: hospitalization and IV antibiotics

** Follow with post treatment urine culture and monthly cultures for remainder of pregnancy

(C) Constipation
- Drink ≥6–8 glasses fluid/d
- ↑ High fiber foods intake
- Exercise

Figure 14.2. Counseling the pregnant patient.

PROM = premature rupture of membranes; PTL = preterm labour; IUGR = intrauterine growth retardation; PIH = pregnancy induced hypertension; SIDS = sudden infant death syndrome; FAS = fetal alcohol syndrome

- Indications for specialty care referral in prenatal women are outlined in Table 14.3.

TABLE 14.3 • Indications for specialty care referral in prenatal women

Maternal Factors	Current Pregnancy Complications	Pregnancy Hx
• Diabetes • Chronic HTN • Obesity (BMI > 35) • Severe psychosocial issues • FHx of genetic disease or congenital anomalies • Other significant FHx: DVT/PE, recurrent pregnancy loss • Significant tobacco, EtOH, drug use • Significant medical illness (heart failure, renal disease, HIV)	• Gestational HTN • Placenta previa (± bleeding) • Ongoing antepartum hemorrhage • Multiple gestation • PPROM • PTL • Rh or atypical blood group sensitization (i.e., C, E) • Hydramnios (poly or oligo) • Fetal malposition (breech, transverse at 36 wk) • Anemia not responding to Fe^{2+} + Hgb < 100 g/L • Fetal congenital anomaly	• PTL < 36 wk • Stillbirth or neonatal death • IUGR, < 10th %, reverse flow Doppler • Cervical incompetence • Prev. uterine surgery

C_2 L E O

Truth Telling

- The physical demands of mother's employment should be considered and risks thereof disclosed to the pt, especially to women at high risk for preterm delivery.
- High cumulative work fatigue scores as the strongest (OR 1.63) work-related RF for PTL

- Common complications of pregnancy and their management are outlined in Table 14.4.

TABLE 14.4 • Initial management of antepartum complications

Antepartum Complications	Initial Management
Discrepancy in SFH—smaller than expected (> 3 cm below expected)	• Review current pregnancy: R/O incorrect dates; possible etiologies for SGA fetus (GDM, placental abnormalities, congenital anomalies on U/S, meds/toxins, smoking) • Review maternal Hx: DM, SLE, HTN; inadequate wt gain, Hx of IUGR in prev. pregnancy • Maternal investigations: BP, urine dip for protein, GDS if not done yet • Fetal investigation: U/S assessment of fetal growth, fluid volume • Based on U/S results ◦ Normal growth and fluid ⚙ Continue with daily kick counts and routine surveillance for SFH growth ⚙ Repeat U/S for growth/BPP if continued SFH lag and/or other risk factors for poor fetal growth exist (e.g., maternal disease, GDM, inadequate wt gain) ◦ SGA/possible IUGR fetus ⚙ Obtain obstetrics consult ⚙ Fetal surveillance: repeat U/S for growth in 2 wk, BPP in 1 wk; add umbilical Dopplers; consider uterine Dopplers if ~24 wk GA ⚙ Investigations: increase surveillance for GHTN, TORCH screen, consider amniocentesis if other AbN on U/S ⚙ Modify controllable factors: smoking and drug use cessation; adequate nutrition; optimize treatment of maternal disease ⚙ Timing of delivery/site of delivery depends on the clinical situation. ◦ Oligohydramnios ⚙ See Clinical Box, Oligohydramnios

(Continued)

TAbLE 14.4 • Continued

Antepartum Complications	Initial Management
Discrepancy in SFH—larger than expected	• Review current pregnancy: R/O incorrect dates, excessive wt gain, GDM, multiple gestation • Review maternal Hx: Hx of LGA infants, IDDM, maternal obesity • Maternal investigations: GDS if not done • Fetal investigation: U/S assessment for growth, fluid volume • Based on U/S results ◦ Normal growth and fluid ○ Continue with daily kick counts and routine surveillance for SFH growth ○ Repeat U/S for growth/BPP if continued SFH discrepancy and/or other risk factors for excessive fetal growth exist (GDM, IDDM) ◦ LGA ○ Consider obstetrics consult ○ Fetal surveillance: repeat U/S for growth in 3 wk, daily kick counts ○ Investigations: GDS if not already done; if normal, consider 2-h OGTT ○ Modify controllable factors: optimize treatment of maternal disease (DM); nutrition and exercise counseling if excessive wt gain ○ Timing of delivery/site of delivery depends on the clinical situation ◦ Polyhydramnios ○ See Clinical Box, Polyhydramnios
Postdates (see Clinical Box, Postdates Pregnancy)	• Review current pregnancy: confirm EDC, confirm low-risk pregnancy (no GDM, GHTN, fetal anomalies), no CI to vaginal delivery • Review maternal Hx: confirm no maternal disease Management: • Offer membrane stripping from 38 to 41 wk • Expectant management until 41 + 0 • Daily fetal kick counts from 40 + 0 • Increase surveillance (Min NST, fluid assessment 2×/wk) at 41 wk • Induction of labor between 41 and 42 GA
↓ FMs	• Review current pregnancy: medications, drug use, S/S abruption • Review maternal Hx: diseases that increase risk of fetal compromise (HTN, DM, etc.) • Fetal investigation: educate re: kick counts, NST ± BPP
Elevated BP	See Hypertensive Disorders in Pregnancy
Diabetes	See Diabetes in Pregnancy
PROM	See Obstetrical Complications
PTL	See Preterm Labor
Bleeding in 2nd or 3rd trimester	See Obstetrical Complications

Amniotic Fluid Disorders

- Amniotic fluid is composed of proteins, carbohydrates, electrolytes, and fetal skin cells and can be measured by U/S.
- Amniotic fluid is essential for proper fetal development as it functions to:
  - Cushion the fetus from external injury
  - Ensure proper MSK development
  - Develop the fetal lungs and GI system
  - Maintain a constant temperature

CLINICAL box

Assessing AFV

1. AFI—measurement and summation of deepest pocket in four quadrants
2. Verification of 2 × 2 cm pocket—U/S survey to verify presence of > 1 to 2 × 2 cm pocket

- Normal amniotic fluid regulation involves an appropriate balance between production and removal, outlined in Figure 14.3.

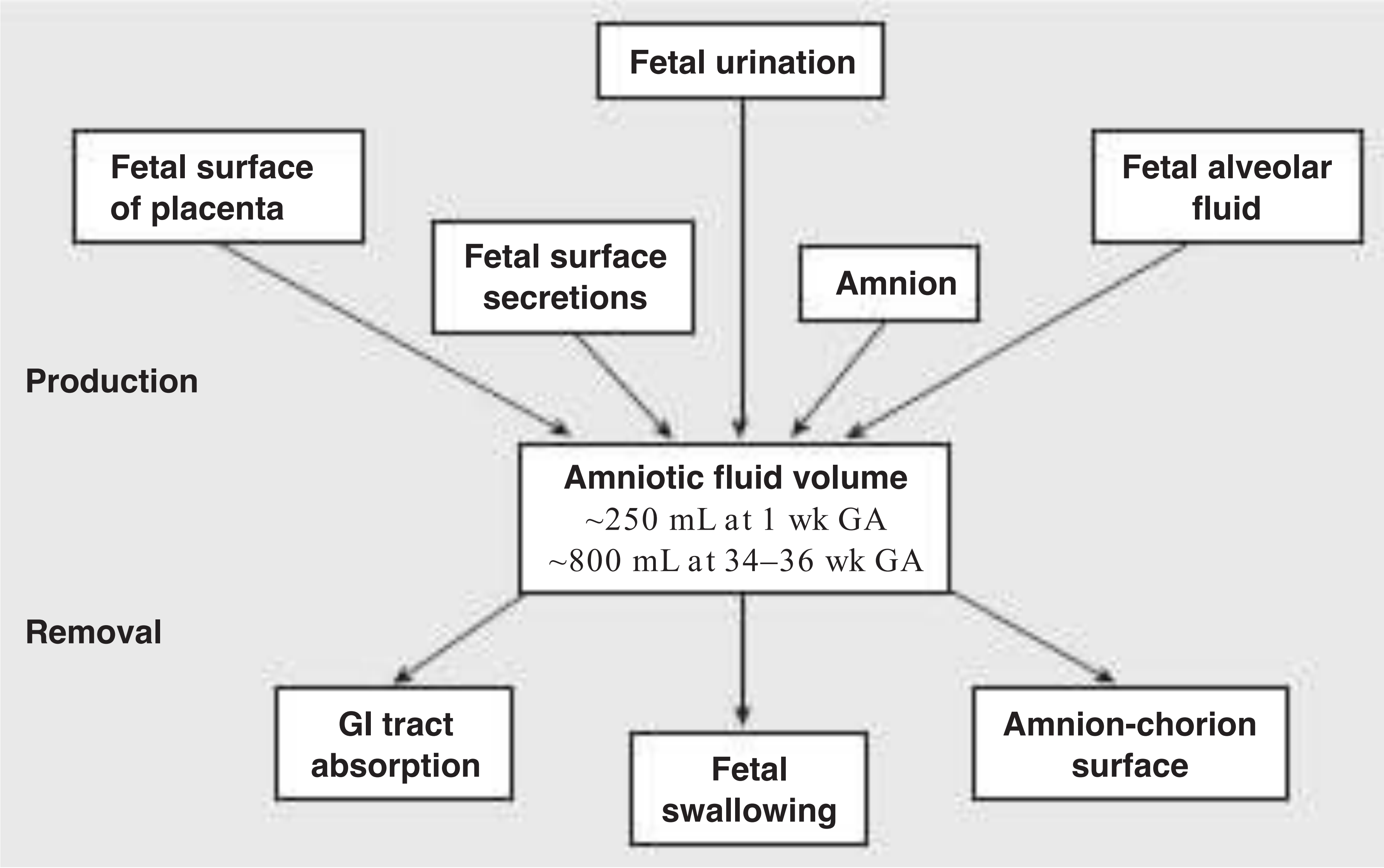
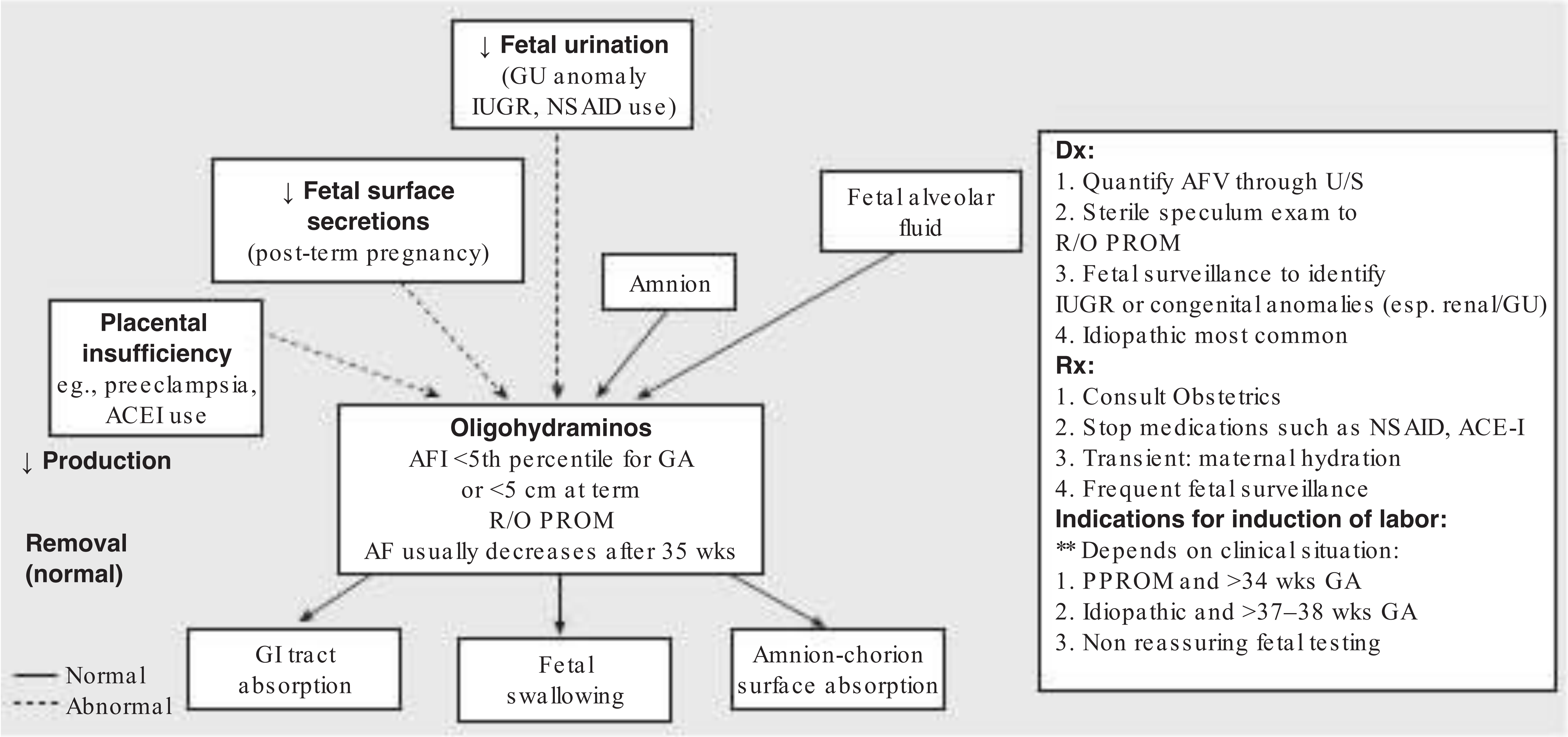


Figure 14.3. Physiology of amniotic fluid regulation.

- Amniotic fluid disorders occur when amniotic fluid is too low (oligohydramnios; Figure 14.4) or too high (polyhydramnios; Figure 14.5).



Dx:
1. Quantify AFV through U/S
2. Sterile speculum exam to R/O PROM
3. Fetal surveillance to identify IUGR or congenital anomalies (esp. renal/GU)
4. Idiopathic most common

Rx:
1. Consult Obstetrics
2. Stop medications such as NSAID, ACE-I
3. Transient: maternal hydration
4. Frequent fetal surveillance

Indications for induction of labor:
** Depends on clinical situation:
1. PPROM and >34 wks GA
2. Idiopathic and >37–38 wks GA
3. Non reassuring fetal testing

Figure 14.4. Pathophysiology of amniotic fluid regulation—oligohydramnios.

CLINICAL box

Postdates Pregnancy

- Pregnancy > 42 wk GA

Etiology

- Idiopathic (majority)
- Anencephaly (rare)
- Placental sulfatase deficiency (rare)

At ↑ Risk for

- Macrosomia
- Postmaturity syndrome
- Oligohydramnios
- Meconium aspiration
- Asphyxia
- Intrauterine infection
- Placental insufficiency
- Fetal distress
- Dystocia

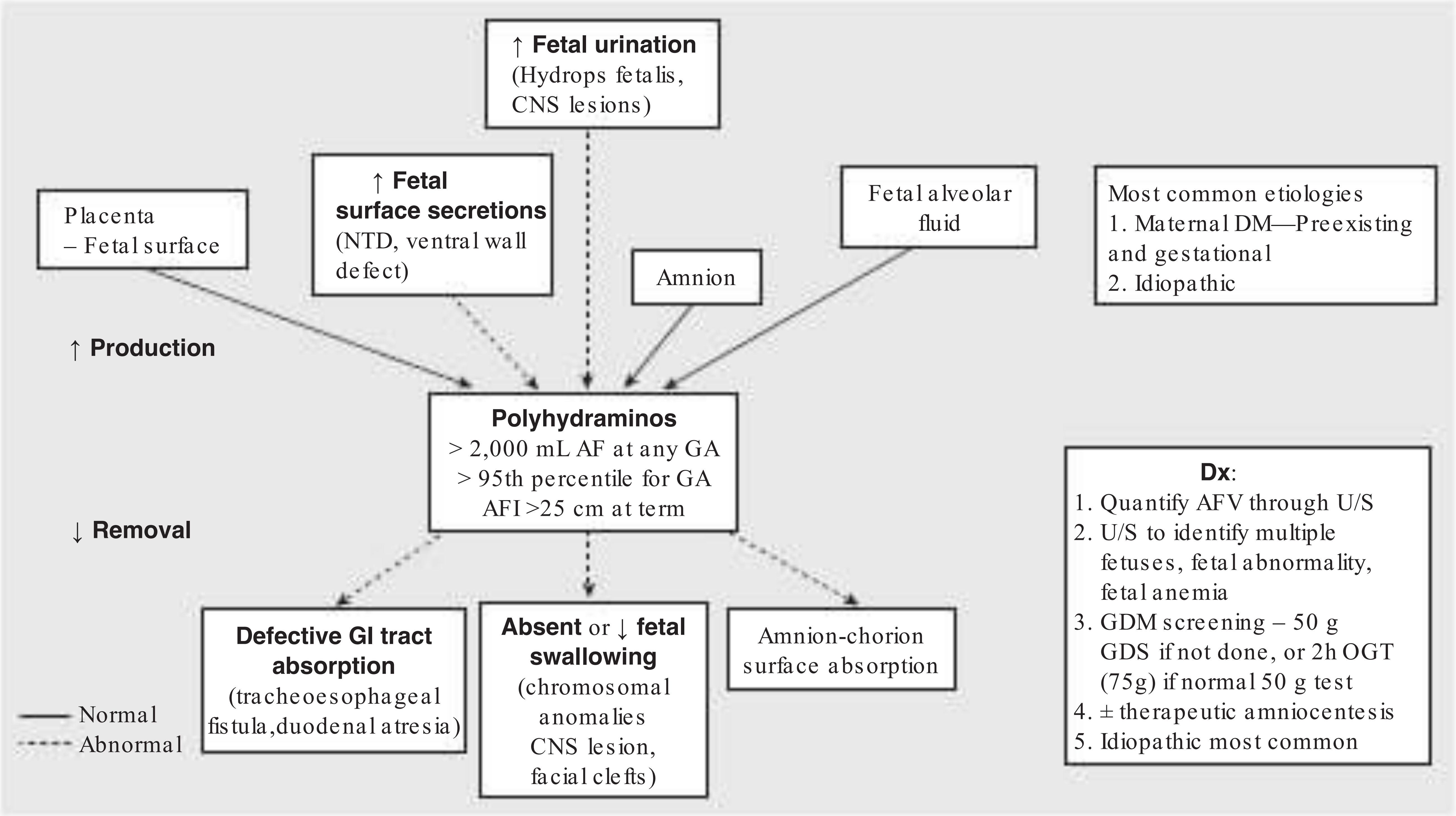

↑ Fetal urination
(Hydrops fetalis, CNS lesions)
↑ Fetal surface secretions
(NTD, ventral wall defect)
Placenta – Fetal surface
Amnion
Fetal alveolar fluid
Most common etiologies
1. Maternal DM—Preexisting and gestational
2. Idiopathic
↑ Production
Polyhydraminos
> 2,000 mL AF at any GA
> 95th percentile for GA
AFI >25 cm at term
↓ Removal
Dx:
1. Quantify AFV through U/S
2. U/S to identify multiple fetuses, fetal abnormality, fetal anemia
3. GDM screening – 50 g GDS if not done, or 2h OGT (75g) if normal 50 g test
4. ± therapeutic amniocentesis
5. Idiopathic most common
Defective GI tract absorption
(tracheoesophageal fistula, duodenal atresia)
Absent or ↓ fetal swallowing
(chromosomal anomalies CNS lesion, facial clefts)
Amnion-chorion surface absorption
Normal
Abnormal

Figure 14.5. Pathophysiology of amniotic fluid regulation—polyhydramnios.

CLINICAL box

Indications for Increased Fetal Surveillance in Pregnancy

Fetal Kick Counting

1. Women with low-risk pregnancies: reinforce the importance of fetal movement in the late 2nd and 3rd trimester of pregnancy. In the event of decreased fetal movement, women should be instructed to do fetal kick counts.
2. Women with high-risk pregnancies: encourage daily kick counts and also PRN when they note decreased fetal movements.
3. Any women noting less than 6 movements in 2 h should be instructed to contact their caregiver or hospital immediately for further testing.
4. Women presenting with concerns of decreased fetal movements should have a maternal and fetal assessment including a NST ± BPP.

NST

- Should be classified as normal, atypical or abnormal (see Table 14.13 for interpretation)
- Indication: decreased fetal movement
  - Normal NST and no risk factors for oligo/IUGR = continue with kick counting
  - Normal NST and risk factors or suspected oligo/IUGR = BPP within 24 h
  - Atypical or abnormal NST = urgent assessment with U/S
- Indication: pregnancies at high risk of adverse perinatal outcome
  - If maternal and fetal status is stable, a normal NST generally indicates favorable outcome for 1 wk.
  - In IDDM or GDM, or postdates pregnancy, frequency of NST is recommended 2× /wk.

BPP (See Clinical Box, Components of Biophysical Profile [BPP])

- Indication: pregnancy at risk of adverse perinatal outcome
  - To be done where expertise is available
  - Abnormal results should be communicated to the responsible physician immediately.
  - 8/10 to 10/10 with normal fluid, 8/8 with no NST = intervention for obstetric/maternal factors
  - 6/10 or 8/10 with low fluid = consult obstetrician
  - 0/10 to 4/10 = immediate delivery required—consult obstetrician

Adapted from the Society of Obstetricians and Gynecologists of Canada (SOGC). *Fetal Health Surveillance: Antepartum and Intrapartum Consensus Guideline 2007.* Ottawa, ON: The Society of Obstetricians and Gynaecologists of Canada (SOGC); 2007. http://sogc.org/guidelines/fetal-health-surveillance-antepartum-and-intrapartum-consensus-guideline/

CLINICAL box

Components of BPP

Component	Criteria
Movement	≥ 3 limb or body movements
Tone	≥ 1 flex/ext of limb or opening/closing hand
Breathing	≥ 30 sec
Amniotic fluid	Min of 2 × 2 cm pocket of cord/limb-free fluid

CLINICAL box

Risk Factors for Development of Gestational HTN

- Nulliparity
- First pregnancy with new partner
- Personal or FHx of HTN
- Extremes of age
- Multiple gestation
- Obesity
- Prev. Hx of GHTN/preeclampsia
- Medical disease (renal, DM, SLE, thrombophilia)
- Abnormal pregnancy (molar/partial mole)

Elevated Blood Pressure in Pregnancy

- Divided into **chronic** (Dx preceding pregnancy or diagnosed at GA < 20 wk) or **gestational** (Dx at GA ≥ 20 wk)
- Occurs in approximately 5% of pregnancies

Definitions:

- HTN: systolic pressure > 140 mmHg or diastolic pressure > 90 mmHg on two occasions
  - Severe HTN: systolic pressure ≥ 160 mm Hg ± diastolic pressure ≥ 110 mm Hg
- Proteinuria—> 300 mg/d protein on 24-h urine collection or > 30 mg/mmol random spot urinary protein/creatinine ratio
- Severe preeclampsia—preeclampsia associated with any severe complication (warrants delivery at any GA)

Dx of Elevated Blood Pressure in Pregnancy (Figure 14.6)

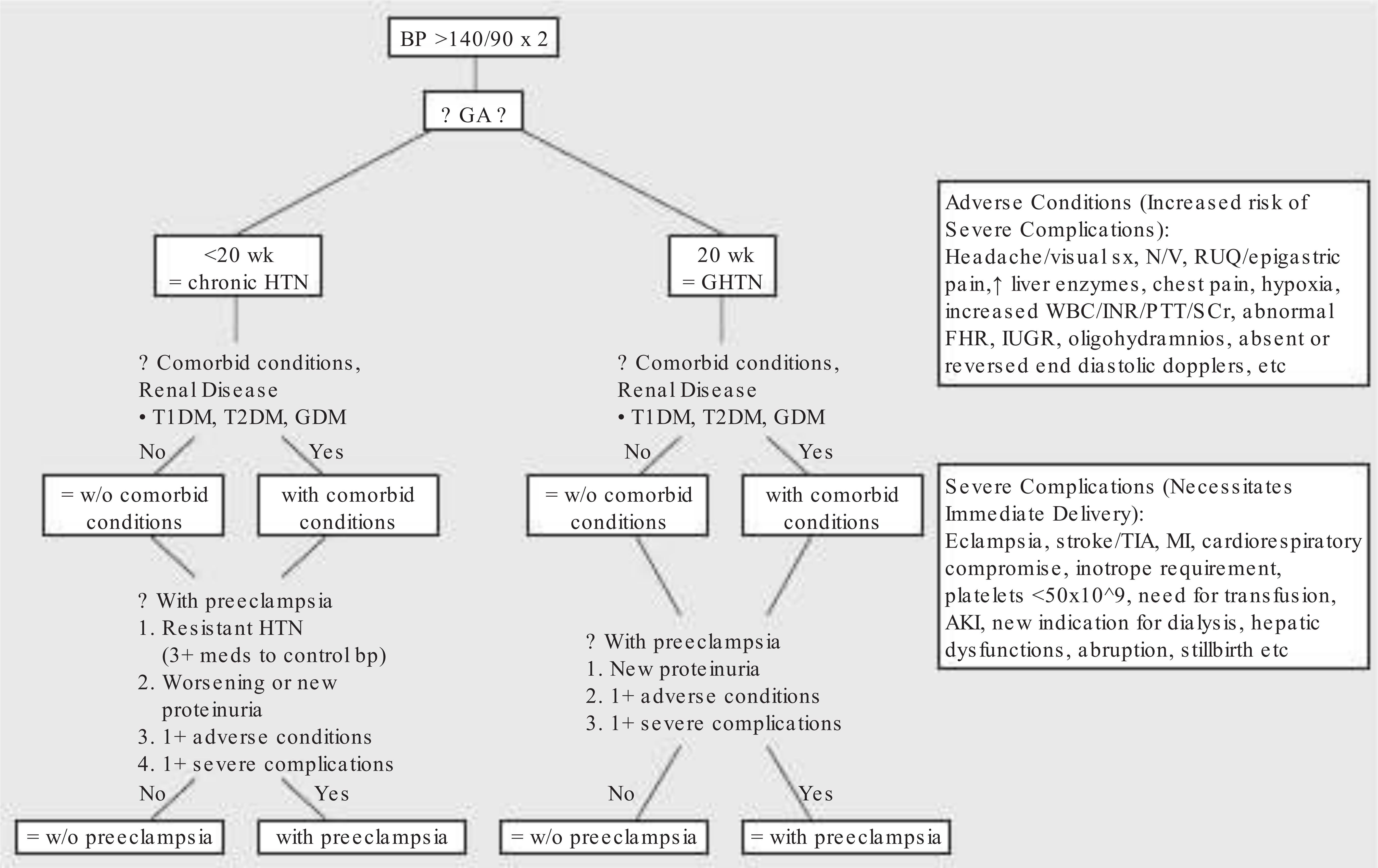

BP >140/90 x 2
? GA ?
<20 wk = chronic HTN
20 wk = GHTN
? Comorbid conditions, Renal Disease
• T1DM, T2DM, GDM
No
Yes
= w/o comorbid conditions
with comorbid conditions
? With preeclampsia
1. Resistant HTN (3+ meds to control bp)
2. Worsening or new proteinuria
3. 1+ adverse conditions
4. 1+ severe complications
No
Yes
= w/o preeclampsia
with preeclampsia
? Comorbid conditions, Renal Disease
• T1DM, T2DM, GDM
No
Yes
= w/o comorbid conditions
with comorbid conditions
? With preeclampsia
1. New proteinuria
2. 1+ adverse conditions
3. 1+ severe complications
No
Yes
= w/o preeclampsia
= with preeclampsia
Adverse Conditions (Increased risk of Severe Complications):
Headache/visual sx, N/V, RUQ/epigastric pain,↑ liver enzymes, chest pain, hypoxia, increased WBC/INR/PTT/SCr, abnormal FHR, IUGR, oligohydramnios, absent or reversed end diastolic dopplers, etc
Severe Complications (Necessitates Immediate Delivery):
Eclampsia, stroke/TIA, MI, cardiorespiratory compromise, inotrope requirement, platelets <50x10^9, need for transfusion, AKI, new indication for dialysis, hepatic dysfunctions, abruption, stillbirth etc

Figure 14.6. Diagnosis of elevated blood pressure in pregnancy.

CLINICAL box

Adverse Conditions

- Maternal symptoms (new/persistent headache, visual disturbances, persistent abdo or RUQ pain, severe nausea and vomiting, chest pain, dyspnea)
- End organ dysfunction (seizure, severe HTN, pulmonary edema, placental abruption)
- Abnormal labs (elevated CR, AST, ALT, LDH; decreased PLT < 100, serum albumin < 20)
- Fetal complications (oligohydramnios, IUGR, IUFD, abnormal umbilical artery Doppler)

Management

- Antihypertensives

Note: target BP 130/80 to 155/105 mm Hg if no comorbidities

  - Methyldopa—250 to 500 mg PO b.i.d. to q.i.d (2 g/d max)
  - b-Blockers—labetalol first line: 100 to 400 mg b.i.d./t.i.d. (1,200 mg/d max)

Note: can also be given IV for emergencies (20 mg IV q30min to max 300 mg IV)

  - Nifedipine XL—20 to 60 mg daily (120 mg/d max)
  - Hydralazine—for emergencies only—give 5 mg IV rpt q30min (max 20 mg IV)
- Hospitalization:
  - For BP > 160/110 mm Hg, or any adverse features
  - Requires obstetrical consult
- Outpatient management
  - Increased surveillance required (weekly clinic visits, daily BP, weekly investigations including blood work and U/S for fluid, fetal well-being)
  - Consider OB consult
- Timing of delivery
  - IOL at ≥ 37 wk for pts with preeclampsia or GHTN
  - Requires OB consult
  - Pts with severe preeclampsia may require earlier delivery—requires OB consult

Diabetes in Pregnancy

- Poorly controlled blood glucose levels during pregnancy are associated with an ↑ risk of polyhydramnios, fetal macrosomia, preeclampsia, operative delivery, birth trauma, and neonatal hypoglycemia.

Classification of Diabetes in Pregnancy

- Preexisting diabetes (type 1 or 2)
- GDM (onset of DM during pregnancy)
  - GDM is usually diagnosed in the late gestation (i.e., T2 pregnancy).
  - If diagnosed before 24 wk, GA is likely undiagnosed type 2 DM. (Consider ordering an HbA_{1c}; if elevated, more likely undiagnosed type 2 DM.)

Dx and Management

- Dx relies on plasma glucose levels following an oral glucose tolerance test. See Figure 14.7 regarding GDM testing and management.
- Complications of GDM can be separated into maternal and fetal categories, outlined in Table 14.5.
- Note that some provinces may use different screening and Dx parameters.
- Be familiar with the local method of GDM screening and Dx.

CLINICAL box

Investigations for HTN in Pregnancy

Maternal

- Hematologic—CBC, blood film, PT/PTT, fibrinogen (if suspecting abruption)
- Liver function—ALT/AST/LDH, serum albumin
- Renal function—uric acid, CR, urinalysis, 24-h urine for protein, or spot urine/creatinine
- Imaging—consider CXR, liver U/S

Fetal

- NST
- U/S for fetal growth, fluid, BPP, umbilical artery Dopplers

CLINICAL box

Complications of ACEI Use in Pregnancy

Note: All ACEI should be stopped immediately in pregnancy or preconception and replaced with antihypertensive known to be safe in pregnancy. Failing to do so can result in:

1. Cranium malformation
2. Renal failure
3. Renal agenesis
4. Oligohydramnios
5. Fetal contractures
6. IUGR
7. IUFD

CLINICAL box

RFs for GDM

1. Prev. Hx of GDM or glucose intolerance
2. FHx of diabetes
3. Prev. macrosomia (> 4,000 g)
4. Prev. unexplained stillbirth
5. Prev. neonatal hypoglycemia, hypocalcemia, or hyperbilirubinemia
6. Advanced maternal age
7. Obesity
8. Repeated glycosuria in pregnancy
9. Polyhydramnios
10. Suspected macrosomia

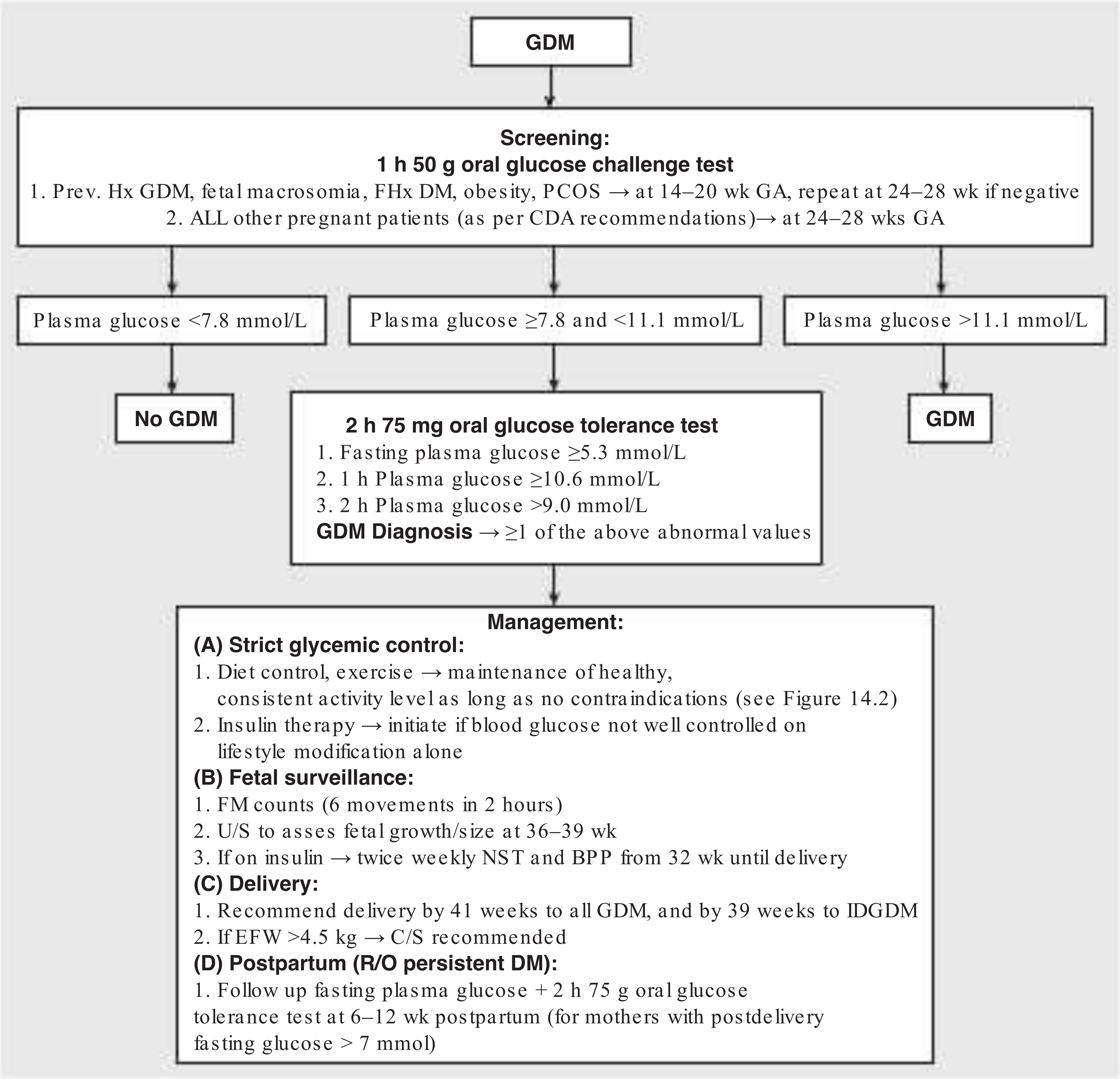

GDM
Screening:
1 h 50 g oral glucose challenge test
1. Prev. Hx GDM, fetal macrosomia, FHx DM, obesity, PCOS → at 14–20 wk GA, repeat at 24–28 wk if negative
2. ALL other pregnant patients (as per CDA recommendations)→ at 24–28 wks GA
Plasma glucose <7.8 mmol/L
Plasma glucose ≥7.8 and <11.1 mmol/L
Plasma glucose >11.1 mmol/L
No GDM
2 h 75 mg oral glucose tolerance test
1. Fasting plasma glucose ≥5.3 mmol/L
2. 1 h Plasma glucose ≥10.6 mmol/L
3. 2 h Plasma glucose >9.0 mmol/L
GDM Diagnosis → ≥1 of the above abnormal values
GDM
Management:
(A) Strict glycemic control:
1. Diet control, exercise → maintenance of healthy, consistent activity level as long as no contraindications (see Figure 14.2)
2. Insulin therapy → initiate if blood glucose not well controlled on lifestyle modification alone
(B) Fetal surveillance:
1. FM counts (6 movements in 2 hours)
2. U/S to asses fetal growth/size at 36–39 wk
3. If on insulin → twice weekly NST and BPP from 32 wk until delivery
(C) Delivery:
1. Recommend delivery by 41 weeks to all GDM, and by 39 weeks to IDGDM
2. If EFW >4.5 kg → C/S recommended
(D) Postpartum (R/O persistent DM):
1. Follow up fasting plasma glucose + 2 h 75 g oral glucose tolerance test at 6–12 wk postpartum (for mothers with postdelivery fasting glucose > 7 mmol)

Figure 14.7. GDM—screening, Dx, and management.

TAbLE 14.5 • Complications due to DM in pregnancy

Maternal	Fetal
A. Obstetric: • Preeclampsia • ↑ Risk of C/S • ↑ Risk of birth trauma • ↑ Risk of operative delivery • ↑ Risk of spontaneous abortion (in preexisting DM only) • Polyhydramnios • ↑ Risk of PTL (associated with polyhydramnios) • ↑ Risk of infection (asymptomatic bacteria, pyelonephritis, vulvovaginitis, respiratory infections)	A. Growth: • Macrosomia • IUGR (preexisting DM only) • Intrauterine Fetal Demise (IUFD) B. ä Risk of structural malformations (only for preexisting DM with elevated HbA_{1c} at conception): • Congenital heart defects • NTD • Skeletal defects
B. Metabolic: ä risk of • DKA (only in preexisting DM) • Severe hemorrhage	

(Continued)

TABLE 14.5 • Continued

Maternal	Fetal
C. Worsening microvascular disease: (only in preexisting DM) • CAD • Retinopathy • HTN • Nephropathy • Neuropathy • Retinopathy D. Postpartum • ↑ Risk infection E. Long-term maternal risks • Recurrence of GDM in future pregnancies • Development of T2DM in women with GDM in pregnancy	C. Neonatal sequelae: • RDS • Hypoglycemia • Hyperbilirubinemia/ jaundice • Hypocalcemia • Polycythemia D. Long-term infant risks: • ↑ Risk of obesity • ↑ Risk of T2DM

Prelabor Rupture of Membranes (PROM)

- **PROM** is the spontaneous rupture of the amnion and chorion before the onset of labor. See Table 14.6 for commonly used definitions.
- **Latency period**: time between ROM and onset of labor.

TABLE 14.6 • Ruptured membranes—definitions

PROM	ROM before labor at any GA
Prolonged PROM	> 24 h between ROM and labor onset
Preterm ROM	ROM before 37 wk GA
Preterm PROM (PPROM)	ROM before 37 wk GA and before onset of labor

- PROM occurs in approximately 10% of all pregnancies and is responsible for approximately 30% of all preterm deliveries. RFs are outlined in Table 14.7.

TABLE 14.7 • PROM RFs

Maternal	Fetal	Pregnancy
• Infection (UTI, STI, cervicitis, vaginitis, intrauterine) • Prev. Hx of PTL or PPROM • Cervical insufficiency or Hx of cervical surgery • Trauma • Smoking • Low SES, poor nutrition	• Multiple gestations • Polyhydramnios	• Amniocentesis • Chronic abruption, Antepartum Hemorrhage (APH) • Cerclage in current pregnancy

CLINICAL box

PROM Prognosis

Spontaneous Labor within 1 wk

- Approximately 50% of women < 26 wk GA
- Approximately 85% of women 28 to 34 wk GA

Complications

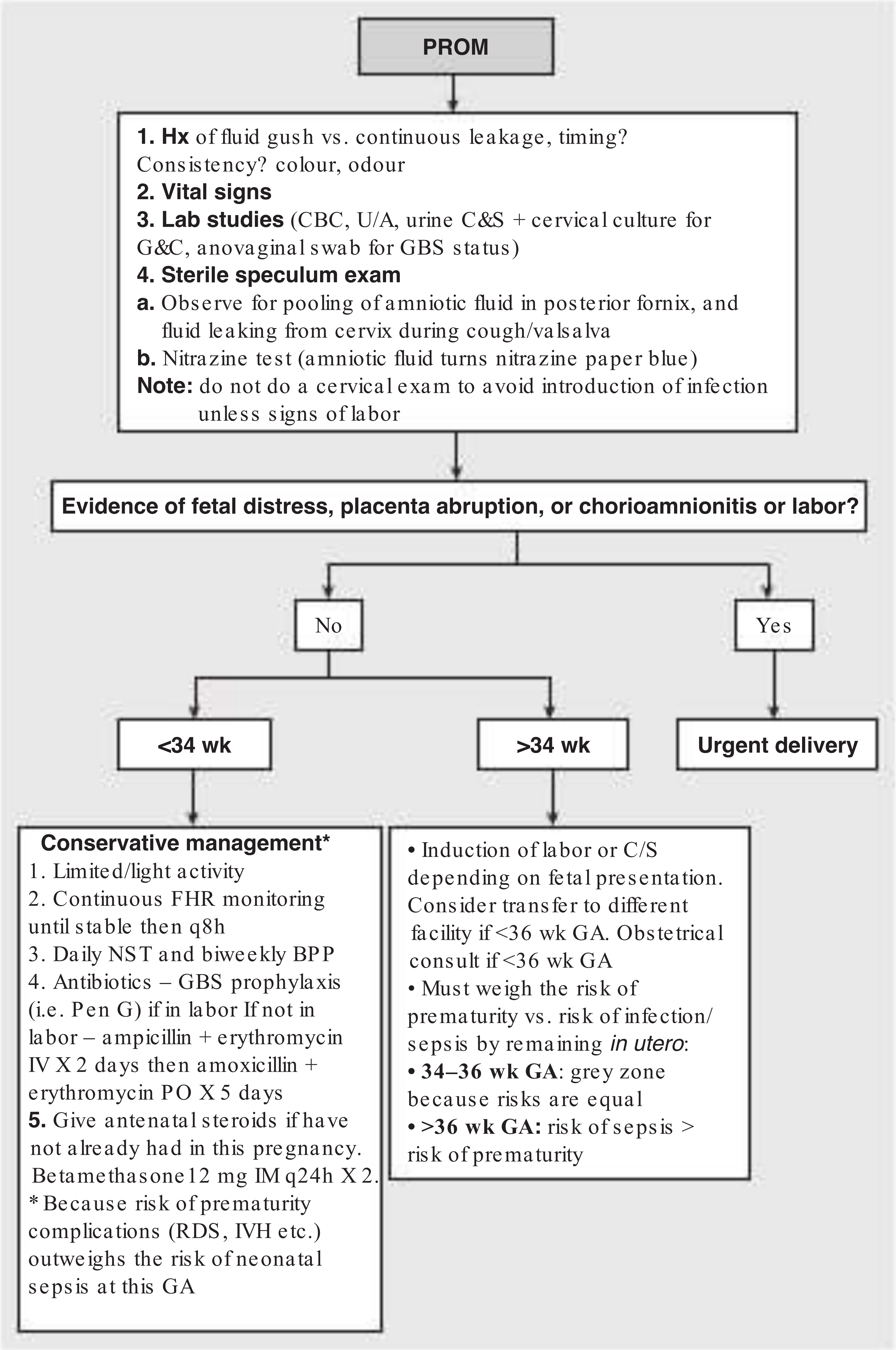
- Chorioamnionitis
- Cord prolapse
- Premature delivery
- Limb contracture

- Confirmation of rupture of membranes should be performed with a sterile speculum exam.
- Depending on gestational age and clinical status, pts may be recommended conservative management to prolong the latency period or expedite delivery through induction of labor or C/S. See Figure 14.8 for an approach to PROM.

PRETERM LABOR

MCC OBJECTIVE

Based on Objective #82 (Preterm Labor) of *Objectives for the Qualifying Examination*, 3rd edition.


PROM
Evidence of fetal distress, placenta abruption, or chorioamnionitis or labor?
No
Yes
<34 wk
>34 wk
Urgent delivery

1. Hx of fluid gush vs. continuous leakage, timing? Consistency? colour, odour
2. Vital signs
3. Lab studies (CBC, U/A, urine C&S + cervical culture for G&C, anovaginal swab for GBS status)
4. Sterile speculum exam
a. Observe for pooling of amniotic fluid in posterior fornix, and fluid leaking from cervix during cough/valsalva
b. Nitrazine test (amniotic fluid turns nitrazine paper blue)
Note: do not do a cervical exam to avoid introduction of infection unless signs of labor

Conservative management*
1. Limited/light activity
2. Continuous FHR monitoring until stable then q8h
3. Daily NST and biweekly BPP
4. Antibiotics – GBS prophylaxis (i.e. Pen G) if in labor If not in labor – ampicillin + erythromycin IV X 2 days then amoxicillin + erythromycin PO X 5 days
5. Give antenatal steroids if have not already had in this pregnancy. Betamethasone 12 mg IM q24h X 2.
* Because risk of prematurity complications (RDS, IVH etc.) outweighs the risk of neonatal sepsis at this GA

- Induction of labor or C/S depending on fetal presentation. Consider transfer to different facility if <36 wk GA. Obstetrical consult if <36 wk GA
- Must weigh the risk of prematurity vs. risk of infection/ sepsis by remaining *in utero*:
- **34–36 wk GA**: grey zone because risks are equal
- **>36 wk GA:** risk of sepsis > risk of prematurity

Figure 14.8. Approach to PROM.

OVERVIEW

- **PTL** is labor (regular contractions causing a cervical D) occurring between 20 and 37 wk GA.
- Occurs in approximately 10% of all pregnancies.
- Very preterm birth occurs at < 32 wk, and extreme preterm birth occurs at < 28 wk GA.
- Preterm birth is the leading cause of infant mortality.

APPLIED SCIENTIFIC CONCEPT

- The exact mechanism behind preterm labor is still unclear, and one or more mechanisms may be at play and could be different in one pt from another. See Table 14.8 for an overview of the likely mechanisms.

CAUSAL CONDITIONS

- Premature activation of the maternal or fetal HPA axis
- Inflammation/infection (chorioamnionitis, decidual)

CLINICAL box

Sx of PTL

Pregnant women should be counselled with regard to the Sx of PTL

- regular uterine contractions
- Pelvic pressure, vaginal bleeding
- D in vaginal discharge
- Low back pain
- Cramping

TAbLE 14.8 • 1° Pathogenic processes leading to preterm delivery and birth

Pathogenic Process	RFs	Postulated Mechanism(s)
Premature activation of the maternal or fetal HPA axis	• Fetal stress: • Placenta insufficiency • Placental pathology • Maternal stress: • Domestic violence • Depression, anxiety • Other life events	• ↑ CRH → ↑ maternal and fetal adrenal cortisol → ↑ production • ↑ Fetal adrenal DHEAS production → ↑ placental E production
Inflammation/infection (chorioamnionitis, decidual)	• GU infection (i.e., asymptomatic bacteriuria, pyelonephritis) • BV • STI • Pneumonia • Peritonitis • Periodontal disease	• ↑ Maternal and fetal cytokines → ↑ PG → ↑ uterine contractions • Proteases and cytokines → break down fetal membranes and cervix
Decidual hemorrhage	• Placenta abruption	• Release of decidual tissue factor • Initiation of coagulation cascade and thrombin production → • Cervical ripening • PPROM • Uterine contractions
Pathologic uterine distension	• Polyhydramnios (AFI > 25 cm) • Multiple gestation • Structural uterine abnormality (i.e., bicornuate, unicornuate)	• Mechanical stretching → • ↑ Myometrial gap junctions • Activation of oxytocin receptors • ↑ PG synthesis

- Decidual hemorrhage
- Pathologic uterine distension

APPROACh

- Establish the age, GTPAL, gestational age, pattern of contractions, Hx of rupture of membranes, vaginal bleeding, presence of fetal movements, and Hx of preterm labor
- Screen for the possible causes of PTL (e.g., fever, dysuria or urinary frequency, abnormal vaginal discharge, productive cough, maternal trauma or motor vehicle accident, known uterine anomaly, recent maternal stress, etc.)
- Review current pregnancy Hx, complications during this pregnancy, and results of routine antenatal investigations (e.g., detailed anatomic ultrasound, gestational diabetes screening)
- Review PMHx, SxHx, meds, allergies, social Hx

Physical Exam

- Vital signs and continuous electronic fetal monitoring
- Abdo exam including Leopold maneuvers
- Focused physical exam based on positive findings on Hx
- Sterile speculum exam if suspicion of PROM
- Cervical exam (only if PROM and placenta previa ruled out) for dilation, effacement, and consistency

CLINICAL box

FFN has a high negative predictive value.

Investigations

- Urine culture and sensitivity
- Vaginal swab for FFN (between 24 and 34 wk GA)

- Vaginal swab for bacterial vaginosis
- Vaginal/rectal swab for GBS
- Cervical swab for gonorrhea/chlamydia
- U/S for cervical length, fetal presentation, amniotic fluid level, and fetal growth

Diagnosis

- Regular uterine contractions leading to cervical dilation and/or effacement

Management

- Management of PTL is highly dependent on gestational age, and accurate dating needs to be confirmed.
- PTL should be managed in the appropriate facility, and a pt may need transfer to a higher level of care if delivery is not imminent.
- Basic management of PTL is summarized in Figure 14.9.

Delivery of a preterm infant can be an emotional time for a pt and family, especially if requiring transfer to a different city. Care therefore involves not only nursing, obstetrics, and pediatrics, but can also include social work, religious services, and other interdisciplinary teams.

Can MED

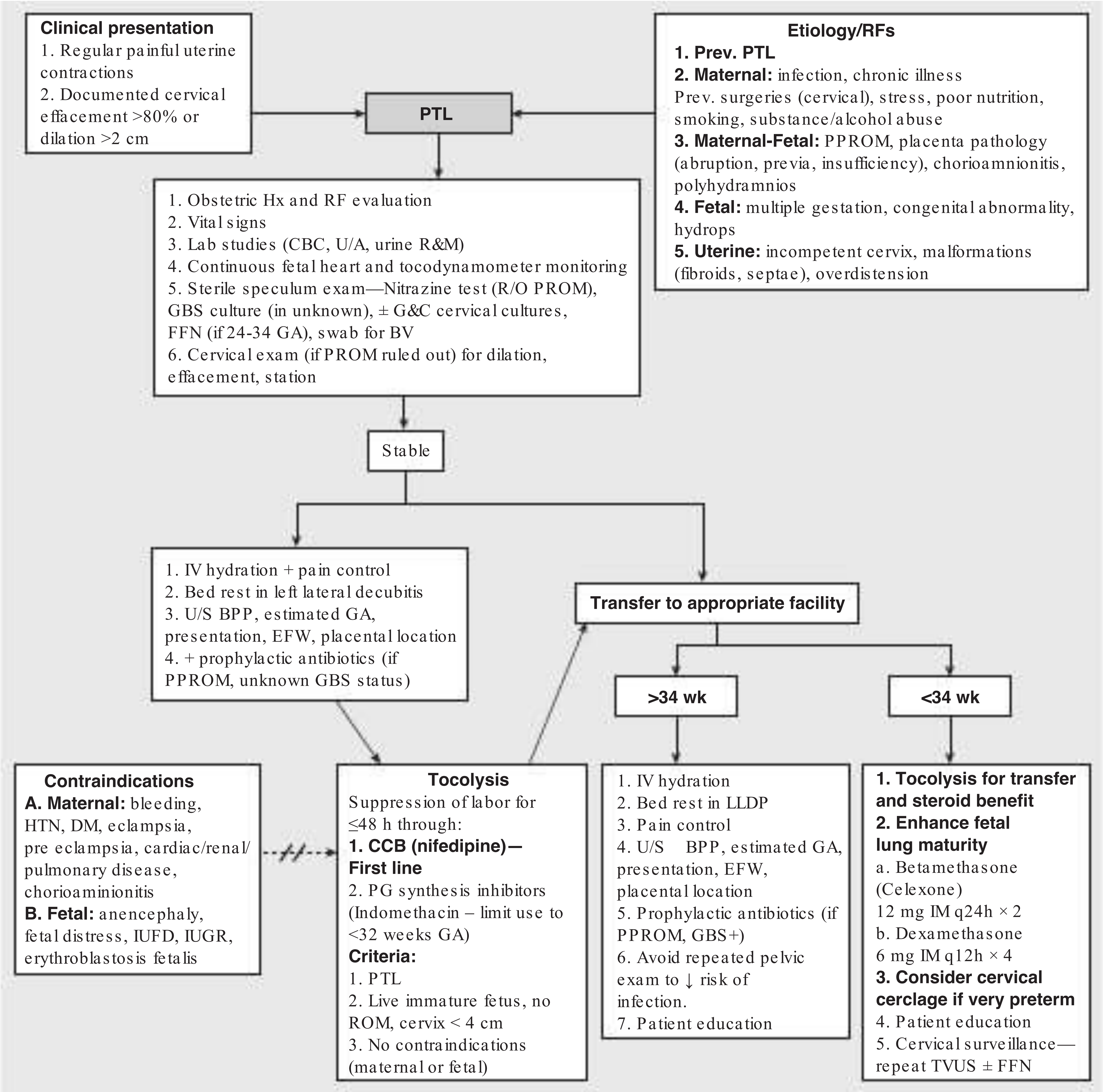

Clinical presentation
1. Regular painful uterine contractions
2. Documented cervical effacement >80% or dilation >2 cm
PTL
Etiology/RFs
1. Prev. PTL
2. Maternal: infection, chronic illness
Prev. surgeries (cervical), stress, poor nutrition, smoking, substance/alcohol abuse
3. Maternal-Fetal: PPROM, placenta pathology (abruption, previa, insufficiency), chorioamnionitis, polyhydramnios
4. Fetal: multiple gestation, congenital abnormality, hydrops
5. Uterine: incompetent cervix, malformations (fibroids, septae), overdistension
1. Obstetric Hx and RF evaluation
2. Vital signs
3. Lab studies (CBC, U/A, urine R&M)
4. Continuous fetal heart and tocodynamometer monitoring
5. Sterile speculum exam—Nitrazine test (R/O PROM), GBS culture (in unknown), ± G&C cervical cultures, FFN (if 24-34 GA), swab for BV
6. Cervical exam (if PROM ruled out) for dilation, effacement, station
Stable
1. IV hydration + pain control
2. Bed rest in left lateral decubitis
3. U/S BPP, estimated GA, presentation, EFW, placental location
4. + prophylactic antibiotics (if PPROM, unknown GBS status)
Transfer to appropriate facility
>34 wk
<34 wk
Contraindications
A. Maternal: bleeding, HTN, DM, eclampsia, pre eclampsia, cardiac/renal/ pulmonary disease, chorioaminionitis
B. Fetal: anencephaly, fetal distress, IUFD, IUGR, erythroblastosis fetalis
Tocolysis
Suppression of labor for ≤48 h through:
1. CCB (nifedipine)—First line
2. PG synthesis inhibitors (Indomethacin – limit use to <32 weeks GA)
Criteria:
1. PTL
2. Live immature fetus, no ROM, cervix < 4 cm
3. No contraindications (maternal or fetal)
1. IV hydration
2. Bed rest in LLDP
3. Pain control
4. U/S BPP, estimated GA, presentation, EFW, placental location
5. Prophylactic antibiotics (if PPROM, GBS+)
6. Avoid repeated pelvic exam to ↓ risk of infection.
7. Patient education
1. Tocolysis for transfer and steroid benefit
2. Enhance fetal lung maturity
a. Betamethasone (Celexone) 12 mg IM q24h × 2
b. Dexamethasone 6 mg IM q12h × 4
3. Consider cervical cerclage if very preterm
4. Patient education
5. Cervical surveillance—repeat TVUS ± FFN

Figure 14.9. Approach to PTL

Abnormal Bleeding in T2 or T3

- Vaginal bleeding in pregnancy is associated with adverse pregnancy outcome.
- APH occurs in 2% to 5% of all pregnancies (Table 14.9).

TAbLE 14.9 • Common etiologies and risk factors for APH

Etiology	RF	Clinical Dx	Management
Abruption: separation of placenta from uterus before delivery of fetus (after 20 wk GA)	• Maternal • Age, smoking, cocaine use, HTN, thrombophilia, trauma, Hx of abruption • Fetal • Multiple gestation • Pregnancy • PPROM, chorioamnionitis, polyhydramnios	• Bleeding • Abdo pain • Regular contractions • Uterine hypertonus • Fetal distress	• Investigations • CBC, liver and renal function, coagulation studies including fibrinogen, type and crossmatch • Speculum exam if previa ruled out • Management • Maternal stabilization (large-bore IVs, IV fluids ± blood transfusion) If mother Rh^-, give Rh immunoglobulin • Delivery if fetal distress or term infant • Expectant management if mother and premature infant stable (steroids if < 34 wk, no Tocolysis, consider transfer to higher level facility)
Placenta previa: placenta covers or is close to (< 2 cm) cervical os	• Maternal • Previous previa, age > 35y, parity > 3, previous C/S or uterine surgery, smoking • Fetal • Multiple gestation	• Bleeding • Painless • Digital cervical examination contraindicated due to high risk of severe hemorrhage	• Investigations • U/S to confirm previa • CBC, type and crossmatch • Management • Maternal stabilization as above • If mother Rh^-, give Rh immunoglobulin • Expectant management if GA 24–36 wk and mother/fetus stable • Delivery via C/S at 36–37 wk Note: Delivery should occur at center with adult ICU, blood transfusion. Pt should be consented for hysterectomy and blood transfusion.
Note: if active bleeding, high fetal mortality rate Vasa previa: velamentous insertion of umbilical cord vessels into placenta, so vessels traverse the cervical os before entering the placenta	• Fetal • Multiple gestation • Pregnancy • Previa, bilobed placenta, velamentous cord insertion, IVF pregnancy	• Bleeding • Painless	• Investigations • CBC, type and crossmatch • Speculum exam and Apt test • U/S with color Doppler if vasa previa suspected (before bleed) • Management • Steroids at 28–30 wk GA • Manage as inpt from 30–32 wk GA • Elective delivery at 34–36 wk GA • Emergent delivery if bleeding (50% fetal mortality)
Cervical pathology: (cervical polyp, ectropion, cervical dilation, infection)	• Maternal • Previous cervical polyp, RF for STD • Recent internal exam, intercourse	• Bleeding • Painless or associated with cramping	• Investigations • Speculum exam • Pap smear • Swab for C and G • ± U/S for cervical length if cervix appears short or associated with cramping/contractions • Management • Dependent on etiology • Treat cervicitis • Do not remove cervical polyp—refer to colposcopy if AbN appearing/AbN pap smear

CLINICAL box

Prevention of RhD Isoimmunization

RhD isoimmunization leads to:

a. Fetal/neonatal hemolytic anemia ± hyperbilirubinemia 25% to 30% and/or

b. Hydrops fetalis 25%

The amount of RhD$^+$ blood required to cause isoimmunization is small (< 0.1 mL).

Causes of Isoimmunization

1. Fetomaternal hemorrhage at delivery, Prev. ectopic pregnancy (EP), or prev. abortion
2. Spontaneous antenatal fetomaternal hemorrhage
3. Invasive procedures during pregnancy (i.e., cerclage, amniocentesis)

Prophylaxis for All Rh$^-$ Women

Administration of one prophylactic dose (300 mg) of RhoGAM (↓ rate of developing antibodies to Rh Ag)

1. At 28 wk unless the father of the baby is known to be Rh$^-$
2. Within 72 h of delivery of an Rh$^+$ infant
3. Following T1 miscarriage, threatened miscarriage, induced abortion, ectopic pregnancy, or molar pregnancy
4. Postinvasive procedures (i.e., CVS, amniocentesis, fetal blood sampling)
5. Any T2/T3 bleeding, external cephalic version, blunt abdo trauma

C_2 L E O

Legal Liability for Negligence

- Failure to act on abnormal prenatal screening results may be considered a cause of harm.
- Failure to recognize Rh isoimmunization in a pregnant woman may be considered a cause of harm → due to failure to meet the standard of care.

CLINICAL box

Risk Factors for Antepartum and Postpartum Depression

Social Hx

- Experience of life stress/adverse life event during pregnancy
- Lack of social support
- Domestic violence
- Unplanned pregnancy
- Low socioeconomic status

Maternal Hx

- Hx of depression or anxiety
- Hx of postpartum depression
- Discontinuing antidepressant prepregnancy or during pregnancy

Family Hx

- Depression or postpartum depression

PREGNANCY—INTRAPARTUM CARE

MCC OBJECTIVE

Based on Objective #80-2 (Intrapartum and Postpartum Care) of *Objectives for the Qualifying Examination*, 3rd edition.

CLINICAL box

Signs and Sx of Antepartum and Postpartum Depression

Sx are similar to nonpregnant; however, must be taken into context of regular Sx of pregnancy and the postpartum period.

1. Excessive sleep or inability to sleep
2. Changes in energy level
3. Excessive or lack of appetite
4. Rapid weight changes
5. Significant anxiety and/or panic attacks
6. Irritability and anger
7. Feelings of guilt
8. Feelings of inadequacy and/or failure as a mother
9. Feeling overwhelmed and/or unable to care for the infant
10. Lack of bonding with the infant

!

An Rh$^-$ mother should receive 300 mg of RhIg within 72 h of delivery if her fetus is Rh$^+$, even if she had received her antepartum dose. Blood typing of the fetus can be performed on cord blood or a sample of fetal blood.

CLINICAL box

Signs/Sx of Intimate Partner violence

Pt Behaviors

- Delay in accessing prenatal care
- Missing frequent appointments
- Frequent ER visits
- Noncompliance with medications
- Inconsistent stories regarding injuries
- Avoidance of being examined

Partner Behaviors

- Overly attentive or protective
- Verbally inappropriate with pt or staff

Presenting Complaints

- Chronic pain
- Headaches
- Substance abuse
- Depression
- Anxiety

OVERVIEW

- **Intrapartum care** is the care of the mother and fetus during labor.
- **Labor** is the process by which products of conception are delivered from the uterus by **progressive** cervical **effacement** and **dilatation** in the presence of regular uterine contractions.
- **Braxton Hicks** contractions: irregular contractions, **not** associated with any cervical D or descent of fetus.
- Approximately 85% of pregnant women will undergo spontaneous labor between 37 and 42 wk GA.
- Approximately 15% of pregnant women will undergo labor between (a) 20 and 36 wk GA (**preterm**) or (b) > 42 wk GA (**postterm**).

APPLIED SCIENTIFIC CONCEPT

- Regulation of the myometrial activity of the uterus relies on fetal and maternal paracrine/autocrine factors, as well as intrinsic factors within myometrial cells (Table 14.10). This is because the uterus is **not** densely innervated.

TABLE 14.10 • Four distinct physiologic phases of myometrial activity in pregnancy

Phase	Mechanism(s)
0. Myometrial inhibition	• During pregnancy, uterus remains quiescent because inhibitors active • Putative inhibitors = progesterone, prostacyclin, relaxin, NO, placenta CRH
1. Myometrial activation	• Occurs as term approaches • Uterus activated in response to uterotropins (i.e., E) • Result: (a) uterus become primed; (b) have development of regular, rhythmic contractions
2. Stimulatory	• Stimulation of primed uterus by uterotonic agonists (i.e., oxytocin, PGE_2, PGF_{2a})
3. Involution	• Occurs after delivery • Mediated by oxytocin

- The uterus is meant to enlarge to accommodate a growing fetus while remaining quiescent, and preterm labor occurs when one or more pathogenic processes act to tip the balance from inhibition into stimulation (Table 14.11).

TABLE 14.11 • Factors promoting labor

Factor	Mechanism of Action
Fetal	• Activation of fetal HPA axis → ↑ cortisol which acts on placenta → ↑ E production → ↑ E:progesterone ratio • Result: (a) ↑ PGF_a release; (b) ↑ myometrial response to oxytocin; (c) ↑ contractions
Maternal	• Activation of maternal HPA axis→ possible activation of fetal HPA • Oxytocin → ↑ PG receptors, ↑ oxytocin receptors, and ↑ gap junctions in uterine
Myometrial	• ↑ Free intracellular Ca^{2+} → contraction of uterine myocyte cells • Possible mechanotransduction through stretching or shortening

- The physician's ability to define the current stage in labor and expected duration helps in counseling the pt and partner, especially in a nulliparous women undergoing labor for the first time.

- Knowing the average duration of each phase is essential in differentiating between normal labor and when a pt's labor has stalled and intervention may be required (Table 14.12).

TABLE 14.12 • Stages of labor

		Avg. Duration	
Stage	Definition	Nulliparous	Multiparous
First	Interval between onset of labor to full cervical dilation (10 cm). Divided into two phases.	~10 h	~8 h
	a. Latent phase: begins with onset of regular uterine contractions with slow cervical dilation up to ~3–4 cm	~6.5 h Prolonged > 20 h	~4.5 h Prolonged > 14 h
	b. Active phase: ↑ rate of cervical dilation to maximum, regular contractions, and descent of fetus	Cervical dilation 1.2 cm/h Fetal descent > 1 cm/h	Cervical dilation 1.5 cm/h Fetal descent > 2 cm/h
Second	Interval between full cervical dilation and delivery of infant	~50 min Prolonged (no epidural) > 2 h	~20 min Prolonged (no epidural) > 1 h
Third	Interval between delivery of infant and delivery of placenta	~10 min Prolonged if > 30 min	
Fourth	Interval from delivery of placenta through to the resolution of physiologic Ds of pregnancy	6 wk	

THE CARDINAL MOVEMENTS OF LABOR

Sequence of movements, involving Ds in position of the fetal head that enables the fetus to successfully negotiate the pelvis during labor.

1. Engagement—widest diameter of the fetal head (biparietal diameter) enters the maternal pelvis below the plane of the pelvic inlet.
2. Descent—downward passage of the presenting part through the pelvic floor. Greatest rate is during the second stage of labor.
3. Passive flexion of the fetal occiput permits the smallest diameter of the fetal head (suboccipitobregmatic ~9.5 cm) to be presented for optimal passage through the pelvis.
4. Internal rotation—rotation of the occiput from its original position toward the symphysis pubis (OA), which is ideal, or toward the sacrum (OP). This enables the AP diameter of the fetal head to line up with the AP diameter of the pelvic outlet.
5. Extension—delivery of the fetal head by extension and rotation of the occiput around the symphysis.
6. Restitution and external rotation—with the fetus' head free of resistance, it untwists, causing the occiput and spine to line in the same plane.
7. Expulsion—delivery of the anterior shoulder under the symphysis pubis followed by quick expulsion of the rest of the body.

APPROACH

History

- Establish the age, GTPAL, gestational age, pattern of contractions, Hx of rupture of membranes, vaginal bleeding, and presence of fetal movements
- Review current pregnancy Hx, complications during this pregnancy, and results of routine antenatal investigations (e.g., detailed anatomic ultrasound, gestational diabetes screening, GBS)
- Review PMHx, SxHx, meds, allergies, and social Hx

CLINICAL box

Signs and Sx of Onset of Labor

1. Regular, painful contractions that are increasing in intensity and frequency
2. Vaginal discharge that is thick, mucous-like, or slightly bloody
3. Gush or trickle of vaginal fluid that is watery

Birth Plans

The pt and her partner may arrive with a birth plan. Review the birth plan early on in labor together with the pt and her partner to improve patient–physician communication and to provide culturally sensitive care.

Can MED

Physical Exam

- Vital signs, fetal heart rate, abdominal exam (including Leopold's), and focused physical exam based on HPI
- Sterile speculum exam and/or vaginal exam if indicated

!

Sterile speculum and vaginal exams are contraindicated in known or suspected cases of placenta previa.

!

Cervical exams should be kept to the minimum needed to detect abnormalities in labor progression. They can be uncomfortable, and increasing the number of exams increases the risk of infection.

CLINICAL box

The Vaginal Exam in the Management of Labor

A sterile vaginal exam is done to determine cervical dilation and effacement as well as the position and station of the fetus.

1. Dilation is the estimated measure of the diameter of the internal cervical os.
2. Effacement is the shortening and thinning of the cervix expressed as length (cm) or a percentage (0% = no reduction vs. 100% = minimal palpable cervix).
3. Position is the position of the presenting part of fetus relative to the maternal pelvis. Most commonly OA, but can also be OP, or OT.
4. Station is the estimated distance (cm) of the leading presenting part relative to the ischial spines. At the level of the spines = 0 (engaged) versus centimeters below (+ 1 to + 5) and centimeters above (−1 to −5).

Indications for Vaginal Exams in Labor

- On admission (if no suspicion/Dx of placenta previa)
- q2–4h in first stage and q1h in second stage
- At ROM to evaluate for cord prolapse; if pt not contracting, perform sterile speculum exam only
- Before intrapartum administration of analgesia
- When the pt feels the urge to push (to determine if cervix is fully dilated)
- To evaluate cause of ↓ FHR (R/O cord prolapse or uterine rupture)

Fetal Monitoring in Labor (Table 14.13)

TABLE 14.13 • Classification of NST and EFM tracings during labor

	Normal Tracing (Previously "Reassuring")	Atypical Tracing (Previously "Nonreassuring")	Abnormal Tracing (Previously "Nonreassuring")
Baseline	110–160 bpm	Bradycardia 100–110 bpm	Bradycardia < 100 bpm
		Tachycardia > 160 bpm for < 30 min	Tachycardia > 160 BPM for < 30 min
		Rising baseline	Erratic baseline
Variability	6–25 bpm	≤ 5 bpm for 40–80 min	> 80 min ≥ 25 bpm for > 10 min Sinusoidal
	≤ 5 bpm for < 40 min		
Decelerations (see Table 14.14)	None or occasional uncomplicated variables or early decelerations	Repetitive (≥ 3) uncomplicated variable decelerations Occasional late decelerations Single prolonged deceleration	Repetitive (≥ 3) complicated variables: • Deceleration to 70 bpm for 60 sec • Loss of variability in trough or in baseline • Biphasic decelerations • Overshoots • Slow return to baseline • Baseline lower after deceleration • Baseline tachycardia or bradycardia • Repetitive (>=3) complicated variables: Single prolonged deceleration (> 2 min but < 10 min)

(Continued)

TABLE 14.13 • Continued

	Normal Tracing (Previously "Reassuring")	Atypical Tracing (Previously "Nonreassuring")	Abnormal Tracing (Previously "Nonreassuring")
Accelerations	Spontaneous accelerations present (> 2) • Increases 15 bpm lasting 15 s • Increases 10 bpm lasting 10 s if < 32 wks GA Accelerations present with fetal scalp stimulation	Absence of acceleration with fetal scalp stimulation	Usually absent
Action	NST may be discontinued.	NST: continued monitoring required. Arrange BPP.	NST: continued monitoring required. Consider BPP and prepare for possible delivery.
	EFM may be interrupted for periods up to 30 min. If maternal-fetal condition stable and/or oxytocin infusion rate stable.	EFM: further vigilant assessment required, especially when combined features present	EFM: action required Review overall clinical situation, obtain scalp pH if appropriate/prepare for delivery

Adapted from the Society of Obstetricians and Gynecologists of Canada (SOGC). *Fetal Health Surveillance: Antepartum and Intrapartum Consensus Guideline 2007.* Ottawa, ON: The Society of Obstetricians and Gynaecologists of Canada (SOGC); 2007. http://sogc.org/guidelines/fetal-health-surveillance-antepartum-and-intrapartum-consensus-guideline/

- Goal is to reduce perinatal/neonatal mortality and morbidity by early detection of fetal decompensation.
- Achieved by assessment of FHR through fetal cardiotocography (CTG), which allows for simultaneous measures of uterine contractions and FHR.
  - Intermittent auscultation (IA)
    - **Indications:** healthy women with no RFs for adverse perinatal outcomes
    - **Frequency of IA = for one full minute after contraction:** q1h during latent phase, q15–30min in active phase, and q5min in second stage of labor
  - Continuous electronic fetal heart monitoring (EFM)
    - Indications:
      - Nonreassuring auscultation
      - Pregnancies at risk of adverse perinatal outcomes
        - **Maternal:** HTN in pregnancy, diabetes, APH, medical diseases (cardiac, anemia, hyperthyroidism, etc.), morbid obesity, maternal MVA, or trauma
        - **Fetal:** IUGR, prematurity, postdates (> 42 wk or > 41 + 3 with low fluid), oligohydramnios, abnormal Doppler studies, isoimmunization, multiple pregnancy, breech presentation
        - **Intrapartum:** vaginal bleeding in labor, infection, prev. C-section, prolonged ROM (> 24 h), hypertonia, meconium stained fluid, abnormal fetal HR on auscultation
      - Induced, augmented, or prolonged labor
    - Can be done externally through Doppler or internally through a fetal scalp electrode
    - Use of EFM is not associated with a significant improvement in neonatal well-being and has been shown to ↑ rates of medical intervention (i.e., C/S, operative vaginal deliveries).

For types of deceleration seen in labor see Table 14.14.

TABLE 14.14 • Types of decelerations seen in labor

Deceleration	Cause	Description
Early	Head compression → vagal slowing of heart	• Seen in 2nd phase of labor • Uniform shape • FHR: gradual ↓ and return to baseline • Coincides with contraction

(Continued)

TABLE 14.14 • Continued

Deceleration	Cause	Description

Variable	Cord compression	• Variable shape, onset, duration
		• FHR: abrupt drop and return to baseline
		• Most common deceleration seen in labor
		• Complicated:
		  • Deceleration to < 70 bpm
		  • > 60 bpm below baseline
		  • Lasts > 60 sec long

Late	Uteroplacental deficiency due to: (a) maternal hypotension, (b) uterine hyperstimulation, or (c) placental dysfunction Result = hypoxia ± acidosis of fetus	• Uniform shape • Gradual ↓ • Late onset (starts at end of contraction) • Can be associated with change in baseline or ↓ variability

!

Variability

↓ Or absent FHR variability is due to (a) persistent hypoxia leading to acidosis, (b) fetal sleep, (c) medications—that is, narcotics, sedatives, b-blockers, (d) prematurity, and (e) fetal tachycardia. Must investigate if lasts > 40 min!

CLINICAL box

Management of an Atypical or Abnormal FHR Tracing

1. Recheck the tracing
2. Call for backup
3. Change maternal position to LLDP—relieves compression of IVC by the gravid uterus
4. Provide fetus O_2 by 100% O_2 mask to mother
5. Stop augmentation of labor—↓ hyperstimulation
6. Fetal scalp stimulation
7. R/O causes of uteroplacental deficiency (i.e., correct any maternal hypotension—IVFs, ephedrine)
8. Amniotomy
9. Fetal scalp electrode if unable to obtain adequate tracing with external monitoring
10. Measurement of fetal scalp blood pH—(pH ≥ 7.25 = normal, pH ≤ 7.20 = fetal acidosis)
11. ± Amnioinfusion—protects cord from compression

Diagnosis

Normal Labor and Delivery

- Based on the HPI, current pregnancy Hx, obstetrical Hx, and maternal Hx, there should be no contraindications to vaginal delivery.
- The phase and stage of labor can be diagnosed, and normal labor and delivery should follow the expected progress outlined in Table 14.12.

Management

Normal Labor and Delivery

- GBS prophylaxis should be administered if indicated.

CLINICAL box

Group B Streptococcal Prophylaxis

Screening for GBS should be done at 36 wk GA as part of antenatal care in all women (except women with documented GBS bacteruria in current pregnancy or previously affected infant with GBS). Ideally want a minimum of 4 h of intrapartum Rx before delivery; but since bactericidal levels are found in cord blood after 30 min, prophylaxis should still be given even if delivery is imminent.

Indications for Antibiotic Prophylaxis

1. A positive GBS screen
2. Unknown GBS status and other RFs for neonatal disease: (a) Prev. infant with invasive GBS infection, (b) GA < 37 wk, (c) > 18 h since ROM, and (d) GBS bacteriuria in current pregnancy

IV Antibiotics Used

1. Penicillin G 5 million units IV loading dose, then 2.5 million units IV q4h
2. Cefazolin (nonanaphylactic penicillin allergy) 2 g loading dose, then 1 g q8h
3. Clindamycin (anaphylactic penicillin allergy with documented GBS sensitivity) 900 mg IV q8h
4. Vancomycin (anaphylactic penicillin allergy with GBS resistance to Clindamycin or sensitivity unknown) 1g IV q12h

- Optimize nonpharmacologic mechanisms for analgesia and offer pharmacologic or neuraxial analgesia as indicated (Table 14.15).
- During second stage, ensure adequate nursing staff and physician (maternity and pediatric) care are available close to delivery.
- If risk factors are present, prepare for shoulder dystocia by ensuring trained professionals are present.

C_2 L E O

Physician's Legal Liability for Negligence

Failure to recognize RFs for group B streptococcal infection in a pregnant woman

TABLE 14.15 • Medications for pain relief in labor

Medication	Description
Entonox	• A mixture of nitrous oxide gas and O_2 administered through a mask • Patient can control how much gas is inhaled • Can continue its use right up to the moment of giving birth • Effects not passed on to the fetus
Narcotics	• Options: morphine 5–10 mg IM if in early labor, morphine 2.5 mg IV if in active labor or fentanyl 0.5 mg/kg IV • Avoid if their peak action will not have diminished by the time of delivery • Can cause respiratory depression in the neonate, reverse with Narcan 0.01 mg/kg
Regional anesthesia	• Loss of pain sensation occurs below T8/T10 with varying degrees of motor blockade • Must hydrate the patient with dextrose free isotonic IV fluid before initiation of epidural

CLINICAL box

Epidural or Spinal Considerations

CIs

1. Pt refusal
2. Untreated coagulopathy
3. Skin infection of lumbar area
4. Refractory hypotension/hypovolemia
5. Active neurologic disease
6. Septicemia

Risks

1. Infection
2. Maternal hypotension
3. Neurologic complications: spinal headache, back pain, nerve palsies
4. Toxic drug reaction
5. Rare neurologic disease

- There is no benefit to routine episiotomy at normal deliveries, but can be done to facilitate vaginal delivery when indicated (Table 14.16).

TABLE 14.16 • Episiotomies

Types	• Median (midline)—incision through the central tendon of the perineal body ◦ Advantage = easy repair and improved healing • Mediolateral—incision through the levator ani bulbocavernosus, and superficial transverse perineal muscles ◦ Advantage = ↓ likely to extend into anal sphincter and rectum
Indications	• Delivery with a high risk of perineal laceration • Soft tissue dystocia • Immediate delivery of compromised fetus • Instrumental delivery (optional)
Possible complications	• Infection • Hematoma • Fistula formation—rectovaginal • Fecal incontinence • Median → likely to extend into anal musculature/rectal mucosa • Mediolateral → ↑ scar tissue, ↑ blood loss, ↑ pain, ↑ difficult to repair, dyspareunia sequelae

- Active management of the third stage of labor should always be performed.

Operative Deliveries

- Operative vaginal deliveries are generally indicated when an abnormal or atypical EFM tracing necessitates expedited delivery or insufficient pushing in second stage.
- Cesarean section is one of the most commonly performed surgeries, and indications are outlined in Table 14.17.

TAbLE 14.17 • Types of operative deliveries

	Definition	Indications	Complications

Vacuum extraction	• Operative vaginal delivery
	• Suction/traction instrument used to deliver the fetus
		• Abnormal or atypical EFM tracing
		• Prolonged 2nd stage
		• Impaired pushing by mother (exhaustion, ↑↑↑ analgesia)
			• Neonatal injury
			  ◦ Soft tissue trauma
			  ◦ Hemorrhage, cephalohematoma, subgaleal, intracranial
			• Maternal perineal (3rd and 4th degree) and vaginal lacerations and/or hematomas
			• Maternal urinary retention
			• Bladder/uterus/pelvic nerve injury
			• Infection
			• PPH

Forceps	• Operative vaginal delivery
	• Classified according to level + position of the fetal head in the birth canal at the time the forceps are applied
	• Types: low/outlet forceps, mid forceps, and high forceps
		• Abnormal or atypical EFM tracing
		• Prolonged 2nd stage
		• Impaired pushing by mother (exhaustion, ↑↑↑ analgesia)
			• Neonatal injury
			  ◦ Soft tissue trauma
			  ◦ Subgaleal hematomas, intracranial hemorrhage
			  ◦ Facial nerve palsy
			  ◦ Skull fracture
			• Maternal perineal (3rd and 4th degree) and vaginal lacerations and/or hematomas
			• Maternal urinary retention
			• Bladder/uterus/pelvic nerve injury
			• Infection
			• PPH

C/S	Low transverse incision (most common)	• Maternal → active herpetic lesions, maternal illness (PIH, GDM, invasive cervical CA) • Fetal → distress, malpresentation, cord prolapsed • Combined → Failure to Progress (FTP), placenta abruption/previa	• Anesthesia • Hemorrhage • Infection • Injury to bladder, bowel, uterus, ureters • ↑ Recovery time/stay in hospital • ↑ Risk of VTE

Shoulder Dystocia

- **Life-threatening emergency**
- Impaction of the anterior shoulder behind the pubic bone after delivery of the head
- Results in the "turtle sign" = retraction of the delivered fetal head against the bottom of the symphysis pubis

RFs

1. **Maternal:** obesity, pelvic abnormality, GDM, postdates pregnancy, Prev. shoulder dystocia
2. **Fetal:** macrosomia
3. **Labor:** prolonged active phase of first stage, prolonged second stage of labor, assisted vaginal delivery (i.e., forceps)

Complications

1. **Maternal:** PPH, symphyseal separation or diathesis, third- or fourth-degree lacerations, uterine rupture
2. **Fetal:** hypoxia ± permanent neurologic damage, brachial plexus injury, clavicular, humerus #, death

CLINICAL box

Management of Shoulder Dystocia

A: Ask for help
L: Lift/hyperflex both legs (McRobert maneuver)
A: Anterior shoulder disimpaction (suprapubic pressure by assistant or Rubin maneuver by MD)
R: Rotation of posterior shoulder (Wood corkscrew maneuver)
M: Manual removal of posterior arm
E: Episiotomy
R: Roll onto all 4s

Induction of Labor

- Occurs when benefits of delivery to either the mother or fetus outweigh the benefits of continuing the pregnancy (Table 14.18)

TAbLE 14.18 • Induction of labor

Requirements	1. Cervical assessment to determine best mode of induction/cervical ripening (see Clinical Box, Cervical Ripening) 2. Normal "reassuring" fetal CTG 3. Cephalic/vertex presentation 4. Access to proper fetal monitoring		
	Maternal Factors	Fetal Factors	Combined Factors
Indications	• GHTN/preeclampsia • Renal or pulmonary disease • Diabetes	• Intrauterine death (IUD) • IUGR	• PROM • Alloimmunization • Postdates pregnancy (> 41 wk GA) • Chorioamnionitis • Abruption at term or with atypical fetal heart strip
Contraindications	• Unstable status • Prev. classical/ T-incision of uterus • Abnormal pelvis structure • ↑↑↑ Cephalopelvic Disproportion (CPD) • Active genital herpes • Invasive cervical CA	• Distress • Malpresentation (transverse, breech) • Preterm (immature lungs)	• Placenta previa • Cord prolapse • Vasa previa
Methods	1. Artificial ROM (amniotomy)—stimulates PG synthesis and secretion 2. Oxytocin (Pitocin)—use minimum dose needed to achieve cervical dilation of ~1 cm/h in active phase		
Risks	• Increased risk of C/S • Uterine hyperstimulation (reversible ↓/stop rate of oxytocin infusion or with b-adrenergic agent) • Uterine rupture • Uterine atony ± PPH • Hypotension—if IV oxytocin is rapidly infused • Water intoxication ± hyponatremia with prolonged use (oxytocin acts as an antidiuretic)		

CLINICAL box

Methods of Induction of Labor

Induction Requiring Cervical Ripening

Mechanical	Foley catheter Double lumen catheter
Medical	Prostaglandin E_2 (intravaginal or intracervical gel, control release gel) Prostaglandin E_1

Induction with a Favorable Cervix

Mechanical	Amniotomy
Medical	Oxytocin

CLINICAL box

Active Management of Third Stage of Labor

Done to help reduce the risk of uterine atony and ↓ postpartum blood loss. Oxytocin is the ideal uterotonic agent due to its (a) short $t_{1/2}$ approximately 2 to 3 min, (b) minimal side effects, and (c) usability in all women.

1. 10 U oxytocin IM or 5 U IV over 1 to 2 min should be given with the delivery of the anterior shoulder.
2. Controlled cord traction

CLINICAL box

Signs of Placental Separation

1. Contraction and rise of the uterus
2. Cord lengthening
3. Gush of blood

!

Never apply cord traction (pull) without counter traction (push) above the pubic bone with one hand

CLINICAL box

Cervical Ripening

- Done to promote softening, effacement, and dilation of the cervix in preparation for induction
- Also ↑ sensitivity of uterus to oxytocin
- Necessity determined by the Bishop score

CLINICAL box

Bishop Score

Cervical Assessment Tool

Components

1. Cervical dilatation (cm)
2. Effacement (%)
3. Station of presenting part
4. Cervical consistency
5. Position of cervix

Score of > 6 = favorable cervix—high success of vaginal delivery

Score of ≤ 6 = cervical ripening recommended (increased risk of failed induction)

Abnormal Labor

- **Dystocia**—the abnormally slow progress of labor **or** FTP (Table 14.19)

TABLE 14.19 • Disorders leading to dystocia in labor

Disorder	Definition	Etiology	Management
Arrest of dilation	Cervical dilation stops for > 2 h in the active phase	Inefficient uterine action	• Appropriate assessment of progress in labor • Augmentation (see Clinical Box)
Arrest of descent	Fetal descent fails to progress for > 1 h during 2nd stage.	CPD (especially if uterine contractions are adequate) Inefficient uterine action	• Appropriate intervention when necessary: • Analgesia • Rest • Ambulation • Amniotomy • Oxytocin augmentation • Fetal health assessment
Protraction of dilation	Slow rate of cervical dilation (i.e., < 1.2 cm primigravida vs. < 1.5 multigravida)		
Protraction of descent	Slow rate of fetal descent during second stage (< 1 cm primigravida vs. 2.0 multigravida)	CPD	
Prolonged latent phase	> 20 h in primigravida and > 14 h in multigravida	Due to improper Dx of early labor	

- Diagnosed when have a failure of:
  - Cervical dilation in the active phase of the first stage → demonstrated by > 4 h of < 0.5 cm/h dilation
  - Fetal head descent in the second stage, despite > 1 h of active pushing
- Three possible causes for FTP are as follows:
  - **Power:** inefficient uterine action (hypotonic, uncoordinated, difficulty pushing by mother)
  - **Passenger**: fetal position (i.e., OP), size, and presence of anomalies (i.e., hydrocephalus)
  - **Passage:** pelvic structure (i.e., CPD), maternal soft tissue factors (i.e., full bladder)

!

Oxytocin is used for both induction and augmentation of labor.

CLINICAL box

Augmentation of Labor

- Promotes adequate uterine contractions when spontaneous labor fails to progress:
  - Slow progression through latent phase (inadequate cervical dilation) or
  - Protraction and/or arrest disorders of labor or
  - Hypotonic uterine contraction pattern
- IV infusion of oxytocin run at 0.5 to 4 mIU/min IV with incremental ↑ of 1 to 2 mIU/min q20–30min
- Reassess progression of labor once at dose of 20 mIU/min

PREGNANCY—POSTPARTUM CARE

MCC OBJECTIVE

Based on Objective #80-2 (Intrapartum and Postpartum Care) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- **Postpartum (Puerperium) care** is the care of the mother and fetus during the 6-wk period following birth. During this period, the reproductive tract returns to its normal nonpregnant state.
- Early postpartum care involves monitoring of maternal vital signs, pain management, and surveillance for complications.
- Education regarding maternal self-care and appropriate activities is key during this time period.
- Commonly encountered postpartum complications are outlined in Table 14.20.

CLINICAL box

Topics to Discuss at Postpartum Check

1. Amount of vaginal bleeding
2. Pain resolution
3. Bowel/bladder function
4. Mood/support
5. Contraception plans
6. Breast-feeding/bottle-feeding

TABLE 14.20 • Common postpartum complications

Complication	Definition	Initial Management
PPH	• Excessive blood loss in the postpartum period • Can be seen as: • Estimated blood loss > 500 mL for vaginal delivery or > 1,000 mL for C/S, or • Any amount of blood loss that threatens a woman's hemodynamic stability, or • A 10% ↓ in Hct between admission and last period • Types: • 1°/early PPH occurs within the first 24 h after delivery. • 2°/late PPH occurs > 24 h after delivery.	• Resuscitation: large-bore IVs ± IVFs, O_2 using mask, cross and type 4 units PRBC, monitor vital signs (BP, HR, Sao_2, RR) • Assess etiology: "4 Ts" • Tone—assess uterine atony • Tissue—explore uterus for retained placental tissue or blood clots • Trauma—explore the lower genital tract for lacerations • Thrombin—review if patient has Hx of coagulopathy (vWD, ASA use, DIC, ITP, etc.) • Investigations: CBC, coagulation profile • Directed Rx: based on findings of assessment
Postpartum fever	• Fever > 38°C on > 2 occasions at least 4 h apart, after the first 24-h postpartum • DDx: • Breast engorgement, mastitis (S. aureus) • Atelectasis, pneumonia • Wound infection——C/S or episiotomy site (polymicrobial) • Endomyometritis • Thrombophlebitis, DVT • UTI/pyelonephritis	Investigations ordered depend on clinical Sx
Postpartum blues	• Commonly occurs in > 80% of new mothers • Usually begins between postpartum day 3 and 10 • Due to adjustment to baby and hormonal Ds	• Self-limited • No need for psychiatric medications • Supportive care
Postpartum depression	• Depression occurring in a woman within 1 y of childbirth • RFs: • Stressful life circumstances • Personal or FHx depression • Poor social supports • Colicky infant • Unplanned pregnancy	• Antidepressants • Psychotherapy • Supportive care

SUGGESTED READINGS

Beckmann CRB, Ling FW, Herbert WNP, et al. *Obstetrics and Gynecology*. 7th ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2013.

Hacker NF, Moore JG, Gambone JC. *Essentials of Obstetrics and Gynecology*. 4th ed. Philadelphia, PA: WB Saunders; 2005.

Liston R, Sawchuck D, Young D, et al; Society of Obstetrics and Gynaecologists of Canada, British Columbia Perinatal Health Program. Fetal health surveillance: antepartum and intrapartum consensus guideline. *J Obstet Gynaecol Can*. 2007;29(9, Suppl 4):S1–S44.Methods of Induction of Labor

CHAPTER

15

Ophthalmology

Imran Jivraj • Matthew T. S. Tennant

Table of Contents

Diplopia
Red Eye
Strabismus and/or Amblyopia
Visual Disturbances / Loss
Pupil Abnormalities

DIPLOPIA

MCC Objective

Based on Objective #23 (Diplopia) of *Objectives for the Qualifying Examination*, 3rd edition.

Overview

Double vision

The visual perception of two images of a single object. Some patients describe double vision as “blurred vision” (Table 15.1). Characterize the diplopia as “monocular diplopia” if the diplopia persists when one of the eyes is covered, and as “binocular diplopia” when the diplopia is relieved when either eye is covered.

Table 15.1 • Classification of diplopia

Type	Manifestation	Cause
Monocular	Diplopia disappears when affected eye is covered and persists when unaffected eye is covered (i.e., the patient sees double when looking only out of the right eye but resolves when the right eye is covered).	refractive, ocular surface, or structural intraocular lesions are the most common causes. Rare cerebral lesions have been reported.
Binocular	Diplopia disappears when either eye is covered, but is present when both eyes are open.	Ocular misalignment due to lesion anywhere along pathway from central brainstem nuclei controlling eye movement, the 3rd, 4th, or 6th cranial nerves, at the neuromuscular junction, or involving the extraocular muscles.

CLINICAL box

Most Common Causes of Diplopia

Monocular: cataract

Binocular: thyroid eye disease

Monocular Diplopia (Table 15.2)

Table 15.2 • Common causes of monocular diplopia

Cornea	Dry eye or ocular surface disease. Astigmatism, corneal opacity (scarring, edema), keratoconus, or other ectasias of the cornea affecting corneal curvature
Lens	Dislocated natural lens or intraocular lens implant Lens opacity: cataract (most common cause)
Vitreous	Opacity, posterior vitreous detachment
Retina	Epiretinal membrane, age-related macular degeneration, macular edema from diabetic retinopathy
Other (rare)	Extra pupillary openings (post laser peripheral iridotomy)

Binocular Diplopia (Table 15.3)

- Vertical (images are above each other), horizontal (images are beside each other), or oblique.
- Comitant: ocular misalignment measures the same amount of prism diopters in all directions of gaze with cover testing.
- Incomitant: misalignment measures different amounts in different directions of gaze (patient will often report that the images are more separated in one position of gaze).

Table 15.3 • Common causes of binocular diplopia

EOMs (restriction, entrapment, or tethering)	Thyroid eye disease (i.e., Graves ophthalmopathy)	Most common—enlargement of extraocular muscles from inflammation or restrictive fibrosis
	Orbital cellulitis Retrobulbar hemorrhage	Ocular emergencies affecting the orbit and extraocular muscles
	Orbital inflammation	Infectious, malignancies, inflammation from, e.g., vasculitis or orbital pseudotumor
	Orbital tumor: primary, secondary to invasion into orbit, or metastatic	
	Blowout fracture of orbital floor or medial orbital wall fracture with prolapse of orbital contents into surrounding sinuses	Entrapment of an extraocular muscle is an emergency. Inferior rectus entrapment presents as impaired upgaze (and may affect downgaze as well) posttrauma. In children, entrapment may occur in a white eye and may be associated with the oculocardiac reflex, which can be life threatening
Neuromuscular junction	Myasthenia gravis	May cause any pattern of binocular diplopia, eyelid involvement with fluctuating ptosis is common. Spares pupillary function
Cranial nerve dysfunction	Isolated cranial nerve palsies (3rd, 4th, 6th) Cavernous sinus syndrome (e.g., fistula, thrombosis)	Compression of cranial nerves by lesions within the cavernous sinus
Brainstem nuclei or internuclear	Brainstem nuclear pathology (tumor, vascular, MS, trauma) Internuclear ophthalmoplegia (often associated with demyelination)	Brainstem disease involving the medial longitudinal fasciculus. Impaired ipsilateral adduction with or without contralateral abducting nystagmus
Paraneoplastic	Rare	

APPLIED SCIENTIFIC CONCEPT (Figures 15.1 and 15.2)

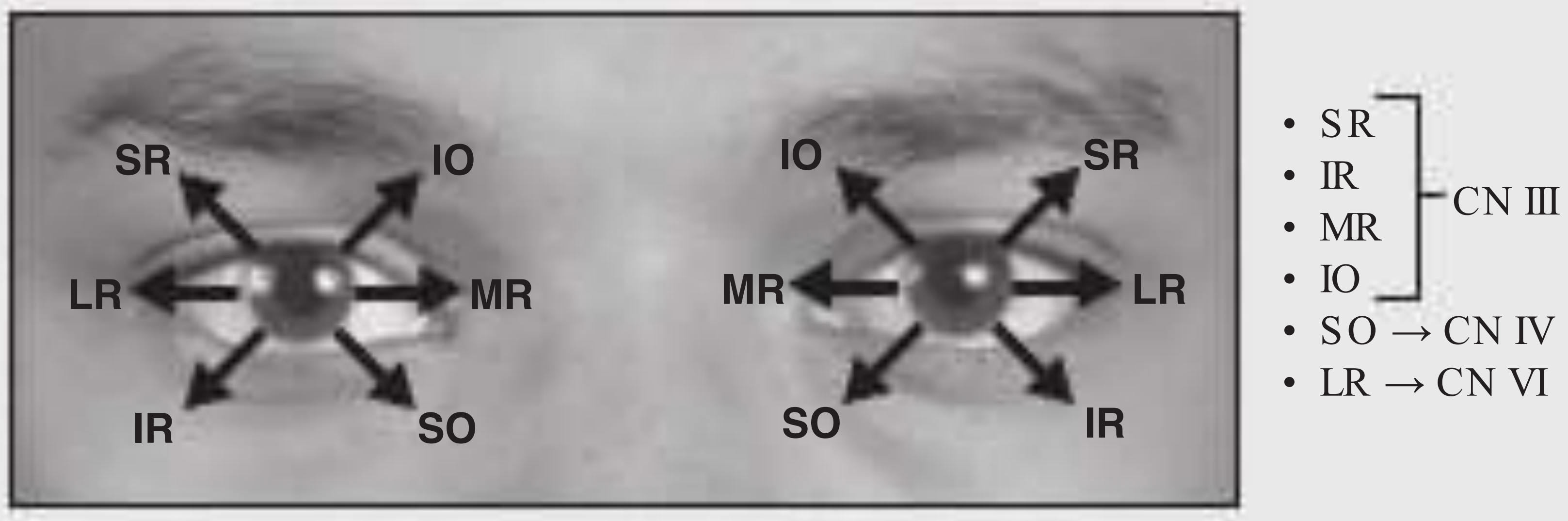


Figure 15.1. Eye movement and EOMs.

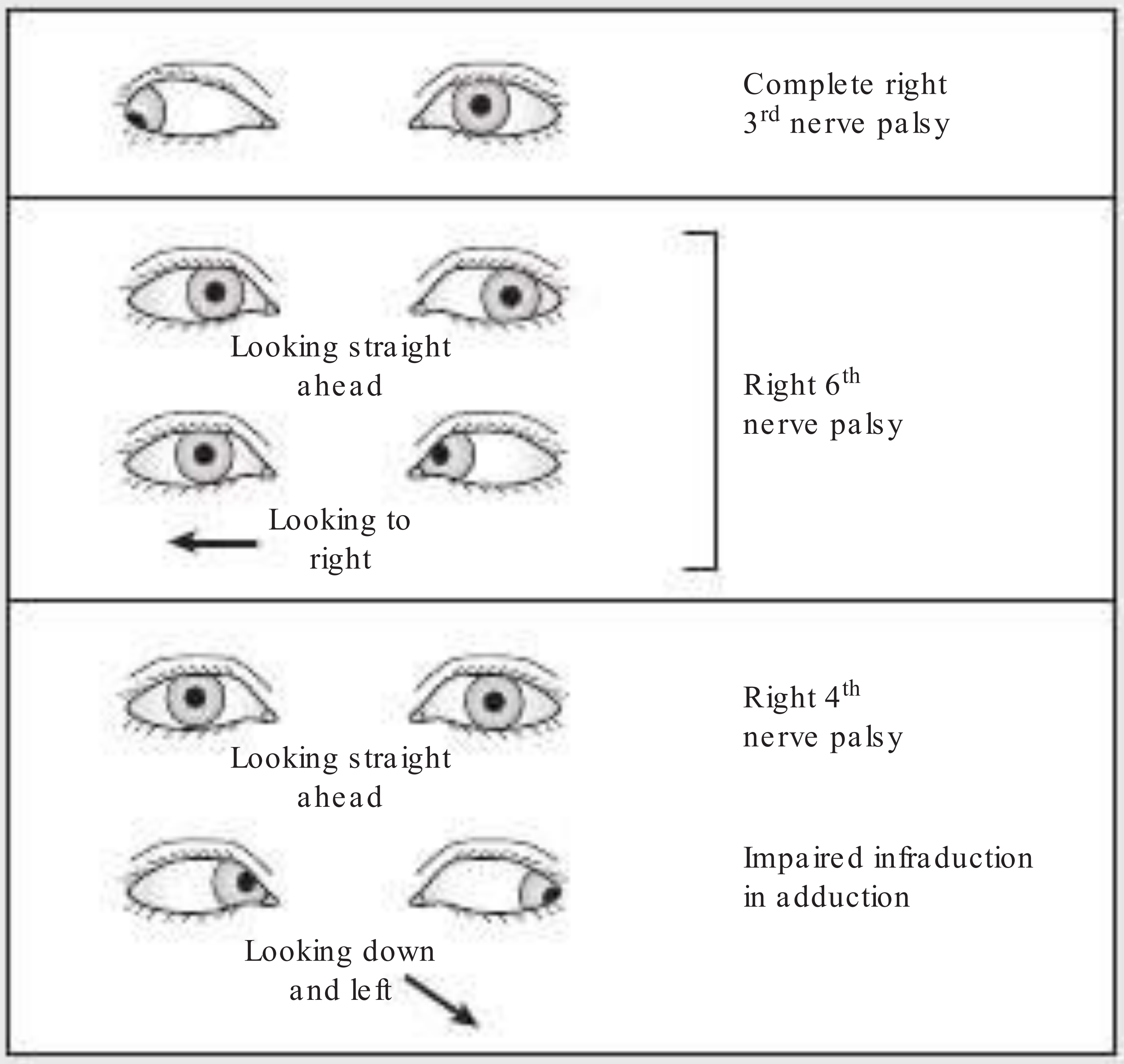


Figure 15.2. Classic nerve palsies.

APPr OACh (Figure 15.3)

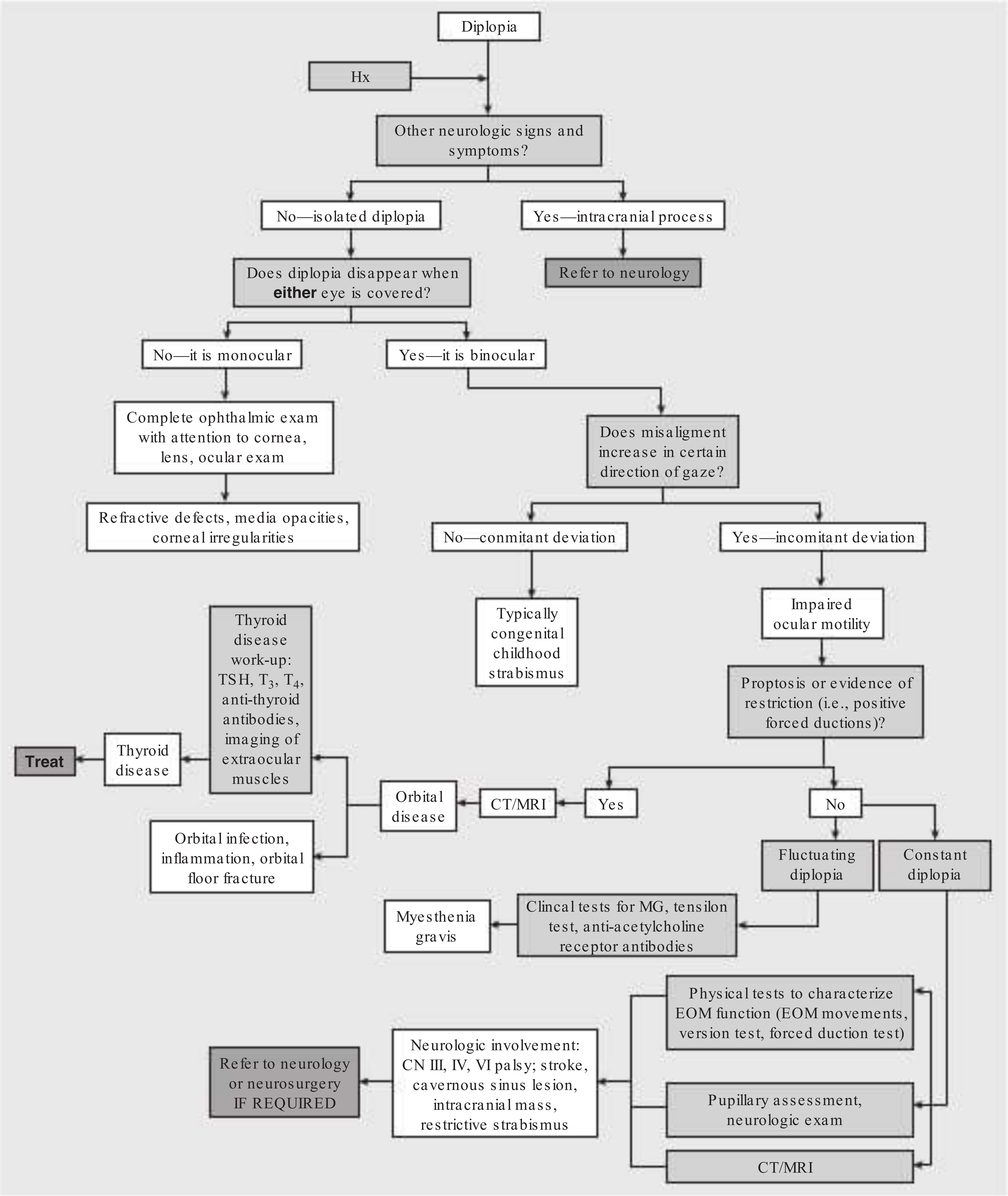

Diplopia
Hx
Other neurologic signs and symptoms?
No—isolated diplopia
Yes—intracranial process
Refer to neurology
Does diplopia disappear when **either** eye is covered?
No—it is monocular
Yes—it is binocular
Complete ophthalmic exam with attention to cornea, lens, ocular exam
Refractive defects, media opacities, corneal irregularities
Does misaligment increase in certain direction of gaze?
No—conmitant deviation
Yes—incomitant deviation
Typically congenital childhood strabismus
Impaired ocular motility
Proptosis or evidence of restriction (i.e., positive forced ductions)?
Yes
No
CT/MRI
Orbital disease
Thyroid disease work-up: TSH, T3, T4, anti-thyroid antibodies, imaging of extraocular muscles
Thyroid disease
Treat
Orbital infection, inflammation, orbital floor fracture
Fluctuating diplopia
Constant diplopia
Clincal tests for MG, tensilon test, anti-acetylcholine receptor antibodies
Myesthenia gravis
Physical tests to characterize EOM function (EOM movements, version test, forced duction test)
Pupillary assessment, neurologic exam
CT/MRI
Neurologic involvement: CN III, IV, VI palsy; stroke, cavernous sinus lesion, intracranial mass, restrictive strabismus
Refer to neurology or neurosurgery IF REQUIRED

Figure 15.3. Approach to diplopia.

History (Table 15.4)

TABLE 15.4 • History of binocular diplopia and correlated interpretation

Inquiry	Outcome or Response	Interpretation or Possible Cause
Onset of diplopia	Sudden onset	Indicates acute processes (i.e., ischemia or trauma)
	Intermittent	Indicates more insidious condition (i.e., slow-growing tumor, myasthenia gravis, or decompensation of longstanding strabismus)
In which direction of gaze is double vision worst? From the patient's perspective, in which position of gaze are the images farthest apart?	Diplopia worst in the same gaze direction as the field of action of the EOM innervated by the cranial nerve	Indicates muscle paresis (e.g., a right 6th nerve palsy would produce worsened horizontal double vision in right gaze)
	Diplopia worst in the direction of gaze opposite to the field of action of an EOM	Indicates muscle restriction (e.g., a fibrosed inferior rectus will produce worsened diplopia and limitation on upgaze)
Does head position or head tilt change the amount of diplopia?	Vertical, horizontal, or oblique separation	May point to palsy of a specific EOM
	Worsened diplopia with head tilt	• 4th nerve palsy (e.g., a right 4th nerve palsy would produce worsened diplopia on right head tilt) • Skew deviation
Was there pain or headache associated with the diplopia?	Generalized headache with features of elevated intracranial pressure (nausea, vomiting, transient visual obscurations, pulsatile tinnitus, morning headache worse with supine positioning)	• Intracranial lesion (tumor, venous sinus thrombosis) may be associated with unilateral 6th nerve palsies from elevated intracranial pressure or any cranial nerve palsy from direct compression • Idiopathic intracranial hypertension is suspected in a overweight female patient with papilledema, absent structural lesion on neuroimaging, elevated CSF opening pressure, normal CSF content, and normal neurologic exam other than 6th nerve palsies. Vitamin A and certain medications may be responsible
	Scalp tenderness, jaw claudication, symptoms of polymyalgia rheumatica (fatigue, proximal muscle weakness), constitutional symptoms	Temporal arteritis may cause any cranial nerve palsy
	Sudden onset of the "worst headache of your life" (thunderclap headache)	Ruptured intracranial aneurysm causing 3rd nerve palsy and subarachnoid hemorrhage
	Pain on eye movement	Orbital cellulitis, myositis or orbital lesion
Does diplopia change as the day goes on?	Fatigability Improves with repeated action	Myasthenia gravis (ocular vs. generalized myasthenia, rule out thymoma). Paraneoplastic conditions, rule out occult malignancy

Physical Exam (Tables 15.5 and 15.6)

TABLE 15.5 • Differentiating isolated cranial nerve palsies

Palsy	Findings	Etiology
CN III	Complete 3rd nerve palsy (urgent—rule out compressive aneurysm) • Complete Ptosis • Impaired elevation, depression, adduction, eye appears to be "down and out" • Dilated pupil Incomplete 3rd nerve palsy • Any combination of the above findings • If pupil involving incomplete 3rd nerve palsy—must urgently rule out compressive aneurysm • If pupil sparing but otherwise complete 3rd nerve palsy, more likely to be microvascular and less likely to be compression from aneurysm in an older patient because pupillary fibers travel on the periphery of the nerve and are first to be affected by a mass lesion. Young patients without vascular risk factors should be imaged	• Compression (e.g., aneurysm of posterior communicating artery) • Ischemic (from brainstem stroke, Giant Cell Arteritis, or microvascular ischemia from diabetes) • Trauma
CN IV	• Hypertropia of the affected side (the superior oblique muscle, which is affected is an incyclotorter and a depressor) that is worse on contralateral gaze and on ipsilateral head tilt • Patient complains of vertical or torsional diplopia	• Trauma • Microvascular ischemia or giant cell arteritis • Compression (e.g., brainstem tumor) • Decompensation of congenital 4th nerve palsy
CN VI	• Horizontal diplopia worse when looking toward the side of the palsied muscle and better when looking away from palsied muscle • Eyes may appear esotropic in primary position.	• Microvascular insult (e.g., ischemia from diabetes) or giant cell arteritis • Compression (tumor, aneurysm, raised intracranial pressure) • Trauma

TABLE 15.6 • Physical signs associated with diplopia

Feature	Interpretation
Head tilt	Typically CN IV palsy. Alternatively, skew deviation
Dilated pupil	Consider pupil involving CN III palsy and R/O posterior communicating artery aneurysm
Ptosis	CN III palsy, myasthenia gravis, Miller Fisher syndrome, etc
Lid retraction	Graves ophthalmopathy
Proptosis	Graves ophthalmopathy, orbital mass or inflammation, retrobulbar hemorrhage if history of trauma, cavernous sinus syndrome, orbital cellulitis
Conjunctival or episcleral injection	Orbital space-occupying lesion, cavernous sinus syndrome, (i.e., cavernous carotid fistula), retrobulbar hemorrhage, orbital cellulitis
Abnormal gait, coordination, speech, hearing, facial movement, facial sensation	Stroke, intracranial mass, neurodegenerative condition, myasthenia gravis

!

Temporal arteritis, although more commonly associated with ischemic optic neuropathy, may also present with any cranial nerve palsy, causing diplopia, and requires urgent investigations (ESR, CRP, CBC) and confirmatory temporal artery biopsy. Treatment consists of high-dose corticosteroids to be given immediately to prevent vision loss.

C_2 L E O

Statutory Requirements and Negligence

- Physicians who diagnose diplopia are required to advise both the patient and sometimes the motor vehicles branch that driving is not permitted unless the diplopia has resolved. Consult individual provincial statutes for specific legal requirements.
- If a motor vehicle accident occurs, the physician who diagnosed diplopia may be legally liable if both the patient and/or the motor vehicles branch (provincial statutes vary) were not advised that driving is not permitted.

CLINICAL box

Imaging Investigations for Diplopia

- CT scan with fine cuts through the orbits is the preferred investigation for orbital mass lesions, Graves ophthalmopathy, and orbital bone imaging in suspected fractures.
- MRI imaging preferred for intracranial lesions (such as the optic chiasm), brainstem, and posterior fossa pathology
- Angiography (CTA, MRA, or conventional) may be required for pupil involving third nerve palsies

RED EYE

MCC OBJECTIVE

Based on Objective #30 (Eye Redness) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Very common ocular sign with a wide DDx. Particular emphasis should be placed on life- and sight-threatening causes of red eye.

CAUSAL CONDITIONS (Table 15.7)

TABLE 15.7 • Common causes of red eye

Orbit	Preseptal cellulitis	Bacterial infection of superficial periorbital tissues and eyelid but not extending posterior to the orbital septum, globe not involved, normal EOM without diplopia, normal pupils with no RAPD; can progress to orbital cellulitis.
	Orbital cellulitis	Life-threatening infection often originating in adjacent sinuses and involving postseptal orbital tissue; if not treated, can progress to cavernous sinus thrombosis or meningitis. Discuss urgently with an ophthalmologist. Inpatient treatment. Maintain a high index suspicion for rapidly progressive fungal infection in diabetic patients.
	Retrobulbar hemorrhage	Collection of blood posterior to globe which compresses the optic nerve and results in acute compartment syndrome, most commonly in the setting of trauma. Eye appears proptotic with reduced EOM, sluggish pupillary reaction and an RAPD, raised intraocular pressure, and reduced vision. Discuss urgently with an ophthalmologist and perform lateral canthotomy and cantholysis immediately.
Lid and lashes	Blepharitis	Chronic inflammation of eyelid margin with scurf, telangiectasias, and eyelash collarettes.
	Hordeolum	Acutely inflamed eyelid gland.
	Chalazion	Chronically inflamed meibomian gland.
Conjunctiva and sclera	Conjunctivitis	Commonest cause of red eye—bacterial, viral, autoimmune (e.g., Reiter syndrome), allergic. Gonorrheal conjunctivitis is a hyperacute purulent conjunctivitis, which can lead to corneal perforation rapidly.
	Subconjunctival hemorrhage	Common, pooled blood under conjunctiva, spontaneous onset, and gradual resolution; if associated with trauma and encircles the cornea 360 degrees, ensure that a globe rupture has been ruled out. Check coagulation profile and offer lubrication and observation. Rarely may be confused with Kaposi sarcoma.

TABLE 15.7 • Continued

	Episcleritis	Common, presents with foreign body sensation or mild irritation, often sectoral injection of superficial vessels, responds to topical lubrication.
	Scleritis	Injection of deep scleral vessels, sclera with bluish color, associated headache and deep ache and soreness around eye, night pain, often associated with systemic autoimmune diseases (e.g., rheumatoid arthritis).
	Pingueculum/ pterygium	Degenerative changes form sun exposure in conjunctiva, causing raised lesion at the limbus often at 3 o'clock or 9 o'clock position.
	Foreign body	Relevant Hx, may have corneal abrasion with vertically-oriented epithelial defects, search carefully under upper and lower eyelid
Cornea	Infectious keratitis (HSV, bacterial ulcer)	White opaque infiltrate on the cornea with associated injection of conjunctiva. With fluorescein staining, an epithelial defect (appears green) is seen overlying the white infiltrate. Often identified the setting of poor contact lens hygiene or poorly managed abrasion.
	Foreign body	Relevant Hx of grinding or trauma, foreign body identified in cornea. Ensure that intraocular foreign body has been ruled out with orbital x-ray.
	Corneal abrasion	History of trauma. Epithelial defect identified by fluorescein uptake (appears green) over the cornea with no white infiltrate. Check pH to ensure no alkali or acid injury has taken place—if pH is markedly altered, generous irrigation with Morgan lens is indicated urgently until normalized.
	Dry eye	May be seen in the setting of prolonged contact lens wear or blepharitis. Mild injection of conjunctiva and speckled pinpoint fluorescein uptake with no confluent epithelial defect. Offer lubrication.
Anterior chamber and iris	Acute angle closure glaucoma	Severe unilateral periorbital headache, nausea, vomiting; patient may see halos around lights, tender, hard eye with raised intraocular pressure usually > 35 mm Hg, fixed mid-dilated pupil, shallow anterior chamber, diffuse conjunctival injection, corneal edema. Discuss urgently with an ophthalmologist.
	Anterior Uveitis	Inflammation of iris (iritis) and/or ciliary body. Present with pain, redness, and photophobia. Pupil may be slightly constricted; WBCs (cells) and flare (proteinaceous aqueous) may be visualized in anterior chamber. Several etiologies including trauma, secondary to corneal pathology, infections such as endophthalmitis, or autoimmune diseases (JIA, ankylosing spondylitis, sarcoidosis, etc.).
	Hypopyon (collection of WBCs)—possible endophthalmitis	Severe inflammation within the anterior chamber with layering of WBCs inferiorly creating a crescent-shaped collection. Rule out endophthalmitis (if recent surgery or recent sepsis, bacteremia) or infectious keratitis if corneal ulcer present. Discuss urgently with an ophthalmologist.
	Hyphema (collection of RBCs)	Crescent-shaped collection of red blood cells inferiorly in anterior chamber, seen in the setting of trauma. Assess intraocular pressure and ensure that a globe rupture has been ruled out.
Always exclude a globe rupture	Globe rupture—also consider the possibility of an intraocular foreign body	360-degree subconjunctival hemorrhage, peaked pupil, full thickness corneal or scleral laceration with prolapsed uveal tissue (dark tissue), obvious leak in the setting of trauma. No pressure should be placed on the eye. Place a protective shield over the eye. Ensure that tetanus status has been addressed. Imaging by CT to exclude intraocular foreign body (MRI contraindicated if metal intraocular foreign body object suspected). Discuss urgently with an ophthalmologist for surgical repair.
Lacrimal system	Dacryoadenitis	Swelling, erythema, and tenderness of lacrimal gland in superolateral orbit.
	Dacryocystitis	Erythema and swelling of skin overlying lacrimal sac inferomedial to the eye with expression of purulent discharge from puncta with pressure over the lacrimal sac. Ensure there is no surrounding cellulitis.
	Nasolacrimal duct obstruction	Persistent unilateral tearing, discharge, crusting, recurrent conjunctivitis, recurrent dacryocystitis. Commonly congenital and resolves in first year of life. May be acquired later in life.

CLINICAL box

Commonest causes of red eye: Conjunctivitis (allergic or viral), Iritis, Foreign body

APPLIED SCIENTIFIC CONCEPT

ASC box

Common Infectious Pathogens in Various Conditions

Blepharitis	
Anterior	Staphylococcus overgrowth
Posterior	Meibomian gland dysfunction
Orbital Cellulitis	
Bacterial	H. influenza (less common in vaccinated population), S. pneumoniae, S. aureus, S. pyogenes
Fungal	Phycomycetes (mucormycosis) and aspergillosis
Conjunctivitis	
Bacterial	S. aureus, S. pneumoniae, H. influenza, Enterococcus, Chlamydia, N. gonorrhea
Viral	Adenovirus, Coxsackie, HSV, HZV
Allergic	Atopic, vernal, or seasonal
Toxic	Topical medications
Granulomatous	Parinaud oculoglandular syndrome
Keratitis	
Bacterial	P. aeruginosa, S. aureus, S. epidermidis, N. gonorrhea, H. influenza
Viral	HSV, HZV
Fungal	Aspergillus spp., Fusarium spp., Candida spp.
Protozoan	Acanthamoeba

ASC box

Ocular Anatomy

Sinuses and Cellulitis

Orbit is surrounded by paranasal sinuses: frontal (superiorly), maxillary (inferiorly), ethmoid (medially), sphenoid (posteromedially). Infection or tumor may spread from the sinuses, particularly ethmoid sinus, into the orbit, causing orbital cellulitis or globe displacement with diplopia.

APPROACH (Figure 15.4)

Uveitis (7 Systems to Review to Identify an Underlying Condition)

1. Rash (HZV ophthalmicus, syphilis)
2. Arthritis or low back pain (ankylosing spondylitis, Reiter syndrome, psoriasis, JIA)
3. GI symptoms (inflammatory bowel disease, Whipple disease)
4. GU symptoms (tubulointerstitial nephritis, IgA glomerulonephritis, urethritis with Reiter syndrome)
5. Mouth and genital ulcers (Behçet disease)
6. Respiratory symptoms (TB, sarcoidosis)
7. Trauma (traumatic iritis, microhyphema)

Note: Uveitis may be secondary to corneal pathology (i.e., corneal abrasions, ulcers, and HSV keratitis), posterior uveitis, or endophthalmitis.

RED EYE IN NEED OF URGENT CARE

Urgent assessment and management should be provided to patients with signs of acute angle closure glaucoma, endophthalmitis, suspected globe rupture, orbital cellulitis, cavernous sinus thrombosis, retrobulbar hemorrhage, and infectious keratitis.

C_2 L E O

Legal Aspects of Medical Records

In a patient with ocular trauma, document preexisting eye disease (such as amblyopia), use of safety precautions (such as safety glasses), condition at presentation, and initial Rx given

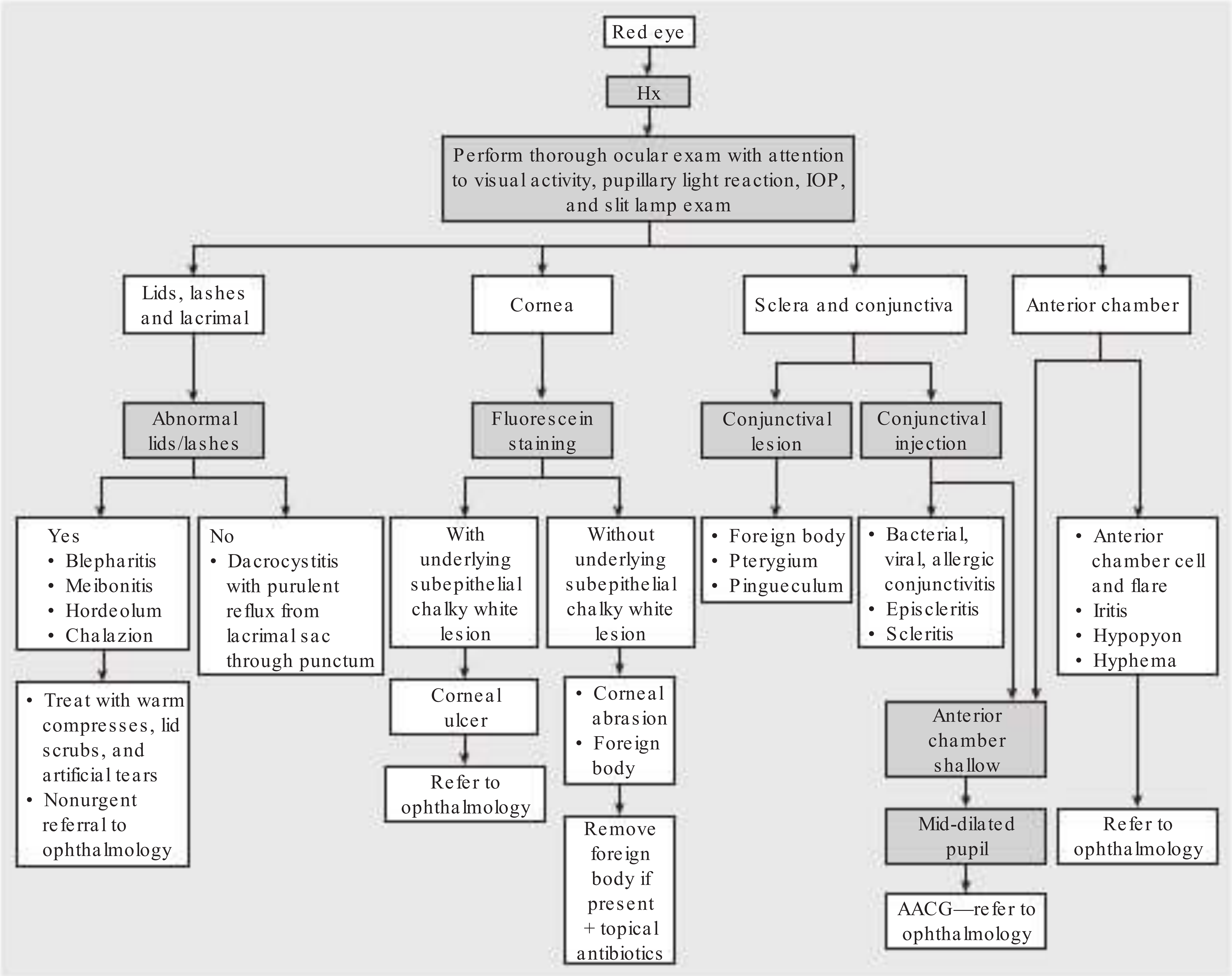

Red eye
Hx
Perform thorough ocular exam with attention to visual activity, pupillary light reaction, IOP, and slit lamp exam
Lids, lashes and lacrimal
Cornea
Sclera and conjunctiva
Anterior chamber
Abnormal lids/lashes
Fluorescein staining
Conjunctival lesion
Conjunctival injection
Yes
• Blepharitis
• Meibonitis
• Hordeolum
• Chalazion
No
• Dacrocystitis with purulent reflux from lacrimal sac through punctum
With underlying subepithelial chalky white lesion
Without underlying subepithelial chalky white lesion
• Foreign body
• Pterygium
• Pingueculum
• Bacterial, viral, allergic conjunctivitis
• Episcleritis
• Scleritis
• Anterior chamber cell and flare
• Iritis
• Hypopyon
• Hyphema
• Treat with warm compresses, lid scrubs, and artificial tears
• Nonurgent referral to ophthalmology
Corneal ulcer
Refer to ophthalmology
• Corneal abrasion
• Foreign body
Remove foreign body if present + topical antibiotics
Anterior chamber shallow
Mid-dilated pupil
AACG—refer to ophthalmology
Refer to ophthalmology

Figure 15.4. Approach to red eye.

CLINICAL box

Key Investigations for Infectious Conjunctivitis and Keratitis

Routine bacterial conjunctivitis does not require cultures. For suspected gonococcal or chlamydial conjunctivitis, and all corneal ulcers that are large (> 2 mm), central, or refractory to initial topical antibiotics, perform Gram stain and/or corneal cultures to identify the causative organism and tailor antimicrobial therapy.

Key Investigations for Iritis

The first presentation of mild iritis does not usually require systemic investigations unless an obvious clinical history suggests an underlying medical condition. However, the workup of recurrent or more severe iritis includes ordering HLA-B27 (ankylosing spondylitis), CXR (for TB and sarcoidosis), PPD skin test, angiotensin-converting enzyme (R/O sarcoidosis), VDRL/FTA-ABS (syphilis).

Management of Iritis

The management of most cases of iritis involves frequent topical steroids and cycloplegic drops. Only ophthalmologists should prescribe topical steroids. Topical steroids should be initiated with caution because they may exacerbate corneal ulcers or dendrites from HSV epithelial keratitis.

Common Causes of Red Eye

Bacterial Conjunctivitis

- History of unilateral or bilateral injection with purulent ocular discharge.
- Treatment with topical broad-spectrum antibiotic drops or ointment (e.g., ciprofloxacin) may expedite recovery. A swab for culture and sensitivity is not clinically useful in the vast majority of cases.

- Systemic antibiotics should be considered in children (e.g., erythromycin).
- If *N. gonorrhea* is suspected based on a hyperacute purulent conjunctivitis, treat the patient for both *N. gonorrhea* and *C. trachomatis* systemically as well as topical antibiotics and frequent ocular irrigation. Discuss with an ophthalmologist (urgently) as well as Local Public Health Authority. Hyperacute gonococcal conjunctivitis may lead to rapid corneal ulceration and perforation.

Adenoviral Conjunctivitis

- History of a red eye followed by second eye involvement 3 to 7 d later, contact with other affected individuals, recent symptoms of URTI, and palpable preauricular or submandibular lymph node. May have subconjunctival hemorrhage, eyelid edema, and chemosis. May develop subepithelial corneal infiltrates (gray-white translucent corneal opacities) after 7 to 14 d, which require treatment by an ophthalmologist.
- Treatment involves topical lubrication with artificial tears, cool lid compresses, copious hygiene (do frequent hand washing, use separate soap and towels, avoid public places because viral conjunctivitis [i.e., adenovirus] is highly contagious).

Herpes Simplex Epithelial Keratitis

- Branched corneal dendrite with terminal bulbs, which stains with fluorescein on the cornea. May be associated with a follicular conjunctivitis and reduced corneal sensation.
- Treat with topical antivirals (such as Viroptic) for corneal dendrite and refer to an ophthalmologist.
  - Never prescribe topical steroids without consulting an ophthalmologist

Herpes Zoster Ophthalmicus

- History of painful vesicular rash affecting the V1 dermatome of the face from reactivation of varicella virus with ipsilateral ocular symptoms. Nasociliary nerve involvement is highly associated with ocular involvement and is suspected when lesions are present on tip or side of the patient's nose (Hutchinson sign).
- Treat rash with oral antivirals (valacyclovir, acyclovir) for 7 to 10 d, cool compresses, and analgesics. Prevent bacterial superinfection of skin lesions with topical antibiotic ointment. Treat postherpetic neuralgia.
- If the patient describes ocular discomfort, photophobia, or decreased vision, or if the eye appears injected or Hutchinson sign is positive, refer to an ophthalmologist for possible involvement of the eye (corneal involvement, iritis, retinal necrosis, cranial nerve palsies, etc.)

Chlamydial Conjunctivitis

- Presents with chronic mucopurulent follicular conjunctivitis
- Swab the conjunctival fornix and perform Gram stain and send specimen for culture and sensitivity
- Empiric treatment should be initiated with systemic antibiotics (azithromycin or doxycycline) as well as topical antibiotics
- Suspicious for maltreatment in children, contact Public Health Authority in all cases
- Refer to an ophthalmologist

Allergic Conjunctivitis

- History of bilateral ocular itching that may be seasonal or associated with a particular environment or trigger
- Remove allergens, cold compresses, topical lubrication, minimize trauma (rubbing, contact lenses)
- Topical treatment with antihistamines (Pataday), mast cell stabilizers
- Systemic antihistamines and steroids for severe allergic symptoms

Management of Ocular Foreign Body—Depends On Location and Extent

Conjunctival

- History of metal work or contact with foreign body and constant ocular foreign body sensation.
- Carefully evert the upper and lower eyelids to locate a foreign body that is not immediately visible. Sweep the fornices with a cotton-tipped applicator and irrigate if a foreign body cannot be identified. Foreign bodies nestled under the upper eyelid may be suspected when corneal examination reveals multiple vertical linear abrasions.

- Remove superficial foreign body on the conjunctival surface. If the foreign body is deep to the conjunctiva and is fixed or embedded in the sclera, refer to an ophthalmologist for removal as it may have entered the eye. A Seidel test may be performed over the site of a scleral laceration (see below) to exclude globe rupture.
- Offer topical broad-spectrum antibiotics (ointments may be more comfortable if there is associated corneal abrasion).
- Perform x-ray orbits to ensure no intraocular or intraorbital metallic foreign body, especially if there is a history of high velocity impact or metal-on-metal hammering.
- Update tetanus status.

Corneal

- Rule out corneal perforation by examining for other signs of globe rupture and perform a Seidel test
  - A positive Seidel test suggests that a laceration of the cornea or sclera is full thickness and has penetrated a wall of the eye.
  - Moisten fluorescein strip with topical anesthetic and paint fluorescein over cornea to produce a dark coat over area of suspected perforation while illuminating under cobalt blue light. Observe the site of the laceration; if a stream of green fluorescein leaks from the wound (indicative of intraocular aqueous humor exiting the eye through the laceration and diluting the coat of fluorescein) then the site is Seidel positive. Seidel positive wounds indicate that the wound is full thickness and requires urgent repair by an ophthalmologist.
- If certain that a corneal foreign body is superficial then it can be removed carefully with a needle tip or burr along with any associated rust ring. Deep, noncentral and inert foreign bodies may occasionally be observed
- Topical antibiotics are prescribed when a corneal or conjunctival abrasion is present
- A patch may be cautiously applied after foreign body removal if the foreign body is thought to be sterile (most metal foreign bodies from grinding are sterile). Never place a pressure patch in contact lens wearers, when there is a history of organic or contaminated foreign body, or in an unreliable patient who will not present for repeated examination in 24 h as the risk of infectious keratitis may increase
- Perform an x-ray orbits to ensure no intraocular or intraorbital foreign body
- Update Tetanus status

Intraorbital or Intraocular

- Suspected in setting of metal-on-metal or high-risk projectile trauma and confirmed with x-ray orbits or CT orbits. An intraocular foreign body necessitates management of a globe rupture as the wall of the eye has been compromised.
- Minimize further damage by avoiding pressure or movement of the foreign body. Place a shield over the eye—do not place a pressure patch!
- Refer to an ophthalmologist immediately.
- Prophylactic systemic antibiotics may be indicated, and systemic steroids may be considered if optic nerve involvement is confirmed.
- Update tetanus status
- Surgical removal of intraocular foreign body by an ophthalmologist is indicated in the vast majority of cases because they may be associated with:
  - Endophthalmitis
  - Optic nerve injury
  - Fistula
  - Chronic ocular deposition, inflammation, and toxicity (e.g., iron and copper)

C_2 L E O

In a patient with chlamydial or gonococcal conjunctivitis, the sexual partners of the patient require identification and treatment. Sexual abuse must be considered in children with chlamydia or gonococcal infections.

!

N. GONORRHEA

N gonorrhea may lead to rapid corneal perforation and is an ocular emergency requiring immediate referral, as well as systemic and topical antibiotics.

C_2 L E O

Negligence

In a patient with eye redness that is painful and associated with diminished or loss of vision, uncertainty about the diagnosis should lead to prompt referral to a specialist (i.e., Worsening of herpes simplex keratitis with topical steroids may lead to physician civil liability.).

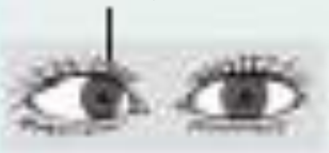
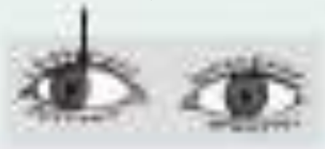
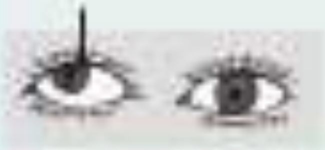
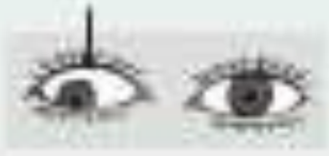
STRABISMUS AND/OR AMBLYOPIA

MCC OBJECTIVE

Based on Objective #102 (Strabismus and/or Amblyopia) of *Objectives for the Qualifying Examination*, 3rd edition.

Overview (Table 15.8)

Table 15.8 • Descriptions of ocular misalignment and strabismus

Phoria	Tropia
• Eyes aligned under normal binocular vision (Cover test reveals no manifest deviation) Affected eye • Misalignment develops when binocular fusion is disrupted (Alternate cover test reveals the deviation) Covered eye; in absence of binocular vision, eye deviates	• Eyes are intermittently or constantly deviated under binocular viewing conditions. Affected eye is misaligned under binocular viewing conditions
Horizontal deviation	
Esotropia—one or both eyes appear to turn in. Affected eye inward 	Exotropia—one or both eyes appear to turn outward. Affected eye outward 
Vertical deviation	
Hypertropia—the affected eye is deviated upward relative to the other. Affected eye upward 	Hypotropia—the affected eye is deviated downward relative to the other. Affected eye downward 

Amblyopia

- Amblyopia is a cause of decreased vision that occurs due to abnormal binocular development. Amblyopia is suspected when the reduction in visual acuity is out of proportion to the ocular findings alone.
- Causes of amblyopia include media opacities (such as congenital cataract), refractive error (either a significant difference in refraction between the two eyes or very high refractive error bilaterally), or strabismus (misalignment of the eyes leading to the suppression of one image). Reduced vision in an eye with a structural problem may be multifactorial (from the lesion itself as well as superimposed amblyopia), and treatment of amblyopic component is often indicated to optimize vision.
- Identification of media opacities necessitates early consideration of surgery to limit amblyopia and improve visual outcome, especially when unilateral. Refractive causes of amblyopia may be treated with corrective prescription glasses, which may be combined with careful patching of the stronger eye and monitoring. Strabismus may benefit from patching, refractive correction, and surgical realignment of the eyes. In all cases of amblyopia, treatment is best initiated early to improve the chances of reversing amblyopia during the period of binocular development.

Strabismus

- Misalignment of eyes leading to a manifest deviation
- May be congenital or acquired, horizontal or vertical, comitant (measured deviation is the same in all directions of gaze) or incomitant (measured deviation varies in different directions of gaze)
- Strabismus is a major cause of amblyopia. In children with strabismus, the image of the eye that is not fixating on the target may be suppressed to prevent diplopia.

CAUSAL CONDITIONS (Table 15.9)

TABLE 15.9 • Causal conditions of strabismus and/or amblyopia

Horizontal Strabismus						
Esotropia Most Common				Exotropia Intermittent (2 y.o.) or Constant		
Congenital	Accommodative	Nonaccommodative	Incomitant	Congenital	Acquired	Convergence Insufficiency
• Presents by 6 mo • FHx • Early surgery	• Refractive: high hyperopic refraction • Nonrefractive: If near deviation is greater than distance deviation, may have an elevated "convergence to accommodation" ratio.	• Sensory (related to poor vision in one eye) • Divergence insufficiency, consider neuroimaging • Postsurgical	• 6th nerve palsy • Medial rectus restriction (thyroid, orbital fracture)	• Rule out neurologic lesion	• Sensory (related to poor vision in one eye) • Intermittent X(T) presents with occasional outturning of an eye and corrected with surgery if >50% of the time or loss of stereopsis	• Difficulty reading, XT identified at near • Treat with orthoptic exercises such as pencil pushups

Vertical Strabismus

- Typically incomitant
- Paresis or restriction of vertically acting muscles or mechanical restriction in vertical movement must be assessed
- DDx:
  - 3rd nerve palsy
  - 4th nerve palsy (unilateral or bilateral)
  - Brown syndrome: restriction of elevation in adduction due to scarring near trochlea or systemic inflammatory conditions affecting trochlea
  - Double elevator palsy—inability to elevate the eye in adduction or abduction. Must be differentiated from a partial 3rd nerve palsy
  - Overaction of superior oblique causes "A" pattern strabismus
  - Overaction of inferior oblique causes "V" pattern strabismus
  - Orbital floor fractures causing inferior rectus restriction
  - Congenital fibrosis syndrome
  - Thyroid ophthalmopathy
  - Myasthenia gravis

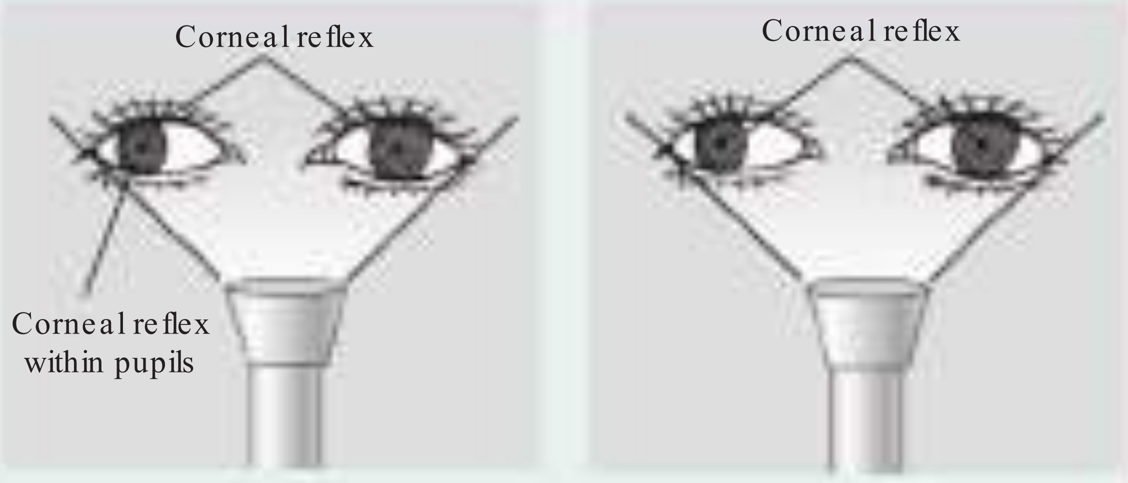
APPROACH (Figure 15.5)

Investigations (Table 15.10)

Divergence Insufficiency

- Pattern of strabismus with an esodeviation measuring greater at distance versus near
- Can be primary (idiopathic) or secondary to head trauma or neurologic lesions
- Because a 6th nerve palsy also causes an esotropia that is worse at distance, neuroimaging is indicated to rule out an intracranial mass lesion affecting the nucleus or path of the 6th cranial nerve.

Table 15.10 • Tests for strabismus—tropia versus phoria

Test		Purpose	Interpretation
Monocular cover/ uncover test	To detect presence of tropia and to differentiate a phoria from a tropia	• Part 1: cover one eye and watch for any movement in uncovered eye • Part 2: remove cover and watch for any movement of initially covered eye	• Part 1: movement of uncovered eye indicates the presence of a tropia • Part 2: movement of the eye as it is uncovered indicates a phoria that becomes manifest when binocular fusion is interrupted
Alternate cover test	To detect presence of phoria and tropia; does not differentiate between phoria and tropia	• One eye is covered for a few seconds and then cover is quickly moved to the other eye, back, and forth between the two eyes • Movement of uncovered eye is observed	• Uncovered eye moving to fixate on target signals the presence of an ocular misalignment (which is the combined tropia and phoria)
Hirschberg test	To assess ocular alignment	• Shine penlight from a distance • Identify whether the light reflex is centered on the pupil or deviated	 Corneal reflex Corneal reflex within pupils Corneal reflex See Figure 15.9 • Light reflex deviated medially suggests that the eye is deviated outward (exotropia) • Light reflex deviated inferiorly suggests the eye is deviated upward (hypertropia)

CLINICAL box

Check the Red Reflex

The red reflex is the red glow emanating from the ocular fundus that is observed through the pupil. Light from a direct ophthalmoscope held a few feet from the patient is directed at both eyes to evaluate the quality and symmetry of the reflex. Examining the red reflex is an essential component of the neonatal, infant, and child examinations. Leukocoria is the identification of an abnormal white reflex which should raise suspicion for concerning intraocular pathology such as Retinoblastoma, retinal pathology, congenital cataracts, and others. Any abnormality in the colour, intensity, and clarity of the reflex requires evaluation by an ophthalmologist.

CLINICAL box

Amblyopia

Even in severe cases, amblyopia is rarely associated with a significant RAPD.

Treatment of Amblyopia

- In anisometropic amblyopia (significant difference in the refractive error of two eyes), correct any significant refractive errors with glasses to optimize the clarity of the retinal image.
- For patients with strabismic amblyopia, patching of the better-seeing eye is performed to promote use of the amblyopic eye. If there is a refractive component to the strabismus (e.g., children with high hyperopia may develop accommodative esotropia), then prescribing glasses may help improve the measured deviation and treat the amblyopia.
- In many cases of strabismus, eye muscle surgery is performed after amblyopia has been managed and vision has been optimized to improve the chances of surgical success and realignment. In other cases, such as congenital esotropia, the ocular misalignment is corrected soon after diagnosis.

VISUAL DISTURBANCES / LOSS

MCC OBJECTIVES

Based on Objective #115-1 (Acute Visual Disturbance/Loss) and #115-2 (Chronic Visual Disturbance/Loss) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Common causes, signs, and symptoms of acute and chronic vision loss are discussed. Diagnostic approach should proceed anatomically, beginning with ocular adnexa through each ocular structure sequentially (cornea, anterior chamber and iris, lens, vitreous, retina, vasculature, optic nerve, and brain).

CAUSAL CONDITIONS (Tables 15.11 and 15.12)

TABLE 15.11 • Common causes of acute visual disturbances

Diagnosis	Common Symptoms and Signs
AACG[a]	Red eye, fixed mid-dilated pupil, high IOP, shallow chamber, corneal edema.
Hyphema	Anterior chamber layering with blood, if total may preclude view of iris.
Subluxed lens	Lens displaced into anterior chamber or posteriorly.
Vitreous hemorrhage	Complete or partial vision loss with new onset "floaters," difficult view of optic nerve on fundoscopy because view is obscured with blood. May occur in posterior vitreous detachments, with retinal tears or detachments, in diabetic patients with proliferative retinopathy, or in macular degeneration, choroidal melanoma, or others.
Central retinal vein occlusion	Sudden reduction in vision with a "blood and thunder" fundus (extensive hemorrhage and cotton wool spots), occasionally disc edema can be appreciated. Evaluate blood pressure acutely and vascular risk factors.
Central retinal artery occlusion	Cherry red spot in the fovea and whitish edematous retina. Evaluate blood pressure acutely and vascular risk factors. May attempt digital massage or lowering intraocular pressure with anterior chamber paracentesis to improve perfusion if an embolus is present. Rule out giant cell arteritis.
Anterior ischemic optic neuropathy[a]	Reduced visual acuity and color vision, unilateral optic nerve head swelling with peripapillary hemorrhages, and a dense RAPD. Suspect arteritic ischemic optic neuropathy—ask about symptoms of temporal arteritis and perform STAT ESR, CRP, and CBC. Refer to an ophthalmologist. Treat with urgent steroids.
Migraine with aura	Colored zig-zags of light in a homonymous visual field lasting ~30 min and completely resolving. May be associated with a headache. History of migraine.
Pituitary apoplexy	Sudden severe headache with vision loss and cranial nerve palsies. Occurs in the setting of a pituitary adenoma with sudden intralesional hemorrhage. Life threatening.
TIA	Monocular sudden vision loss "like a curtain" coming over eye, lasting 5–15 min and abating. Requires urgent evaluation of stroke risk factors and carotid imaging on the same side as the TIA.
Occipital infarct/hemorrhage	Homonymous hemianopsia (respecting vertical midline). May represent posterior cerebral artery ischemia and requires urgent neuroimaging.
Blunt trauma	Corneal abrasion or laceration, hyphema, globe rupture, lens dislocation, vitreous hemorrhage, choroidal rupture, traumatic optic neuropathy.
Penetrating trauma	Globe perforation, intraocular foreign body, optic nerve injury.
Other	Corneal ulcer, chemical splash, increased IOP, endophthalmitis (ocular emergency).

[a] Ocular emergency.

TABLE 15.12 • Some conditions causing chronic visual disturbance

Anterior segment	Corneal	Dystrophy, scarring, edema, keratoconus
	Lens	Cataract: age-related, trauma, steroid-induced, metabolic
	Tumor	Ciliary body or choroidal melanoma, choroidal metastasis, hemangioma

CLINICAL box

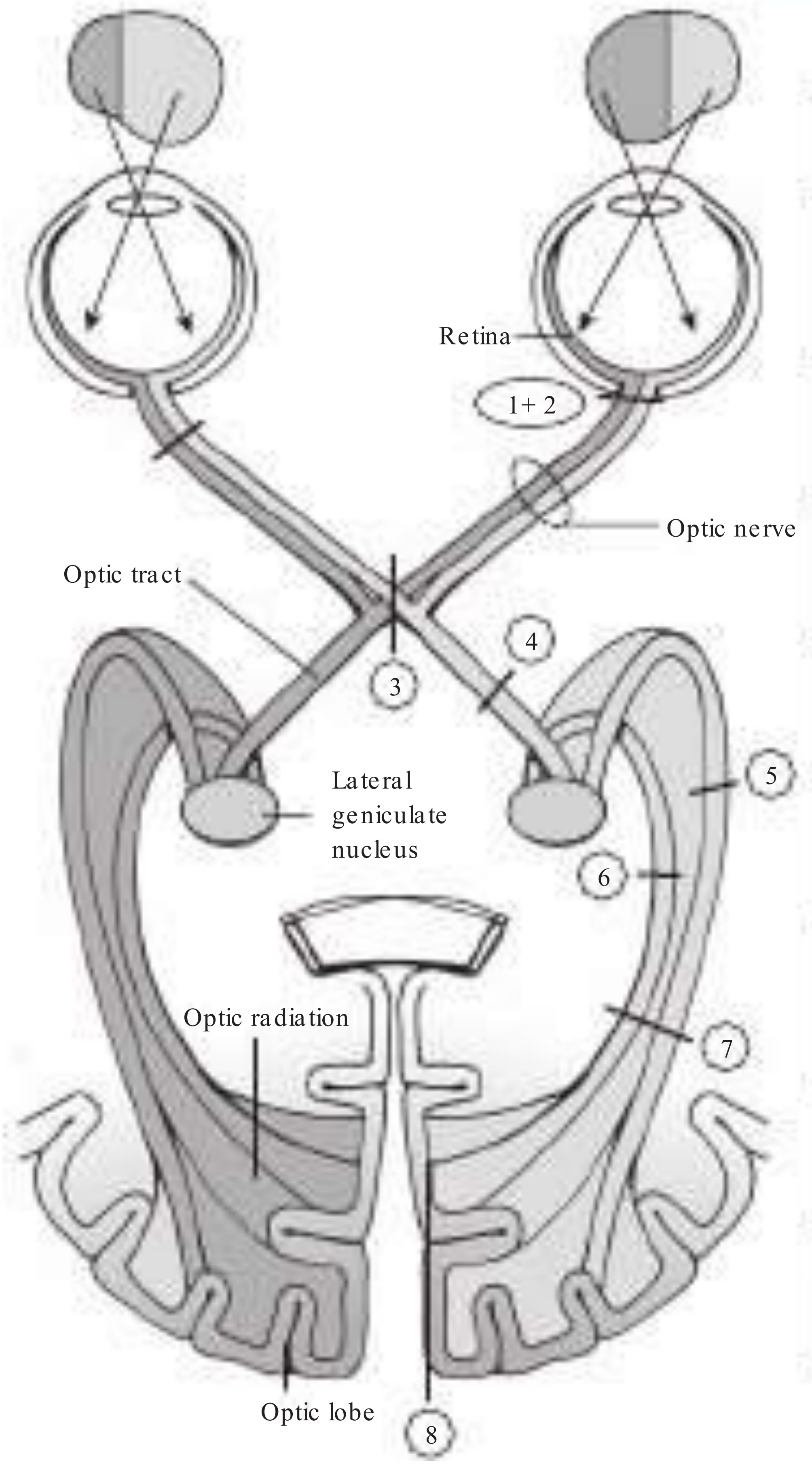
Four common causes of chronic vision loss: cataract, diabetic retinopathy, glaucoma, and macular degeneration

tAble 15.12 • Continued

	Macular	AMD, diabetic retinopathy, macular hole, choroidal dystrophy
Optic nerve and chiasm	Glaucoma	
	Compressive	Optic nerve sheath meningioma or glioma, pituitary adenoma, cyst, etc
	Infiltrative	Lymphoma or leukemia
	Toxic/ Nutritional	Nutritional deficiencies (b_1, b_6 and b_{12}, folate), tobacco-alcohol, amiodarone, chloroquine, hydroxychloroquine, digitalis, ethambutol
	Hereditary	Leber's optic neuropathy (usually acute), dominant optic atrophy, recessive optic atrophy
	Infectious	
	Radiation	

Most common in bold.

Applied Scientific concept (Figure 15.5)



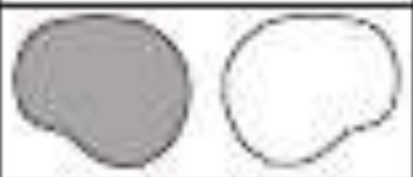
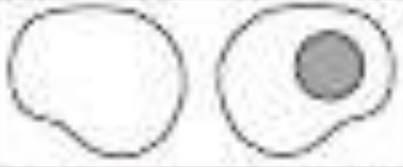
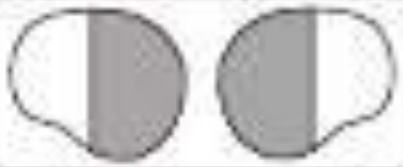
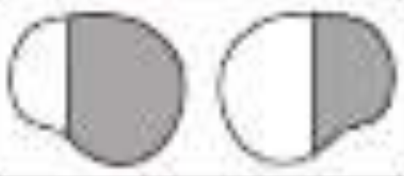
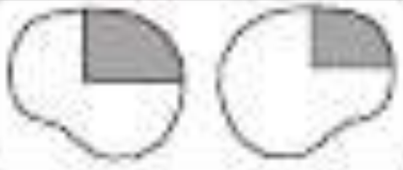
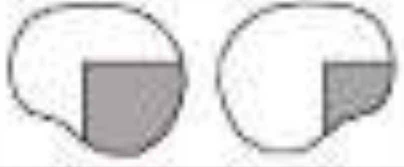
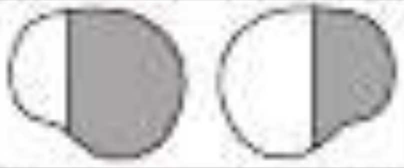
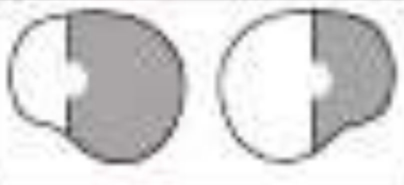
Visual defect	Diagrammatic visual field loss L R	Lesion localization
Monocular vision loss (1)		• CRAO • CRVO • Retinal detachment • Complete lesion of optic nerve
Central or altitudinal scotoma (does not respect vertical midline) (2)		• Optic neuritis (arteritic or nonarteritic ischemia, demyelinating, etc.) • AMD • Branch retinal artery or vein occlusion
Bitemporal hemianopsia (3)		Lesion of the optic chiasm
Right homonymous hemianopsia (4)		Lesion of the left optic tract
Right homonymous superior quadrantopsia (5)		"Pie in the sky" lesion, partial involvement of the optic radiation in the left temporal lobe (Meyer loop)
Right homonymous inferior quadrantopsia (6)		Partial involvement of the optic radiation in the left parietal lobe
Right homonymous hemianopsia (7)		Complete lesion of the left optic radiation
Right homonymous hemianopsia (with macular sparing) (8)		Posterior cerebral artery occlusion (watershed area with macula supplied by both PCA and MCA, thus sparing of MCA)

Figure 15.5. Normal visual pathway (A–G) and visual defects associated with lesions along the visual pathway. A: Light from nasal visual field simulates photoreceptors of temporal retina, and vice versa. B: Photoreceptors transmit signals to bipolar cells and then retinal ganglion cells. Ganglion cell axons form the nerve fiber layer, which carpets the retina and enter the optic nerve. Each optic nerve carries visual information from one eye. C: The two optic nerves form the optic chiasm. D: Fibers from nasal halves of retina (carrying information from the temporal visual fields) decussate at the optic chiasm, and join temporal fibers (carrying information from the nasal visual fields) from the contralateral eye to form optic tracts. Each optic tract carries visual information from the contralateral visual field. E: Each optic tract synapses with neurons at the lateral geniculate body on the same side (some fibers that are involved in light reflex do not reach the LGN and go instead to the pretectal nucleus as part of the pupillary light reflex) (see Figure 15.10). F: From lateral geniculate bodies, signals are transmitted through the geniculocalcarine tract. Fibers that carry visual information from upper contralateral visual fields travel through Meyer loop in the temporal lobes. Fibers carrying visual information from the lower contralateral visual field travel through the parietal lobes. G: Visual information from the contralateral visual field reaches the occipital (calcarine) cortex.

APPROACH (Figures 15.6 and 15.7)

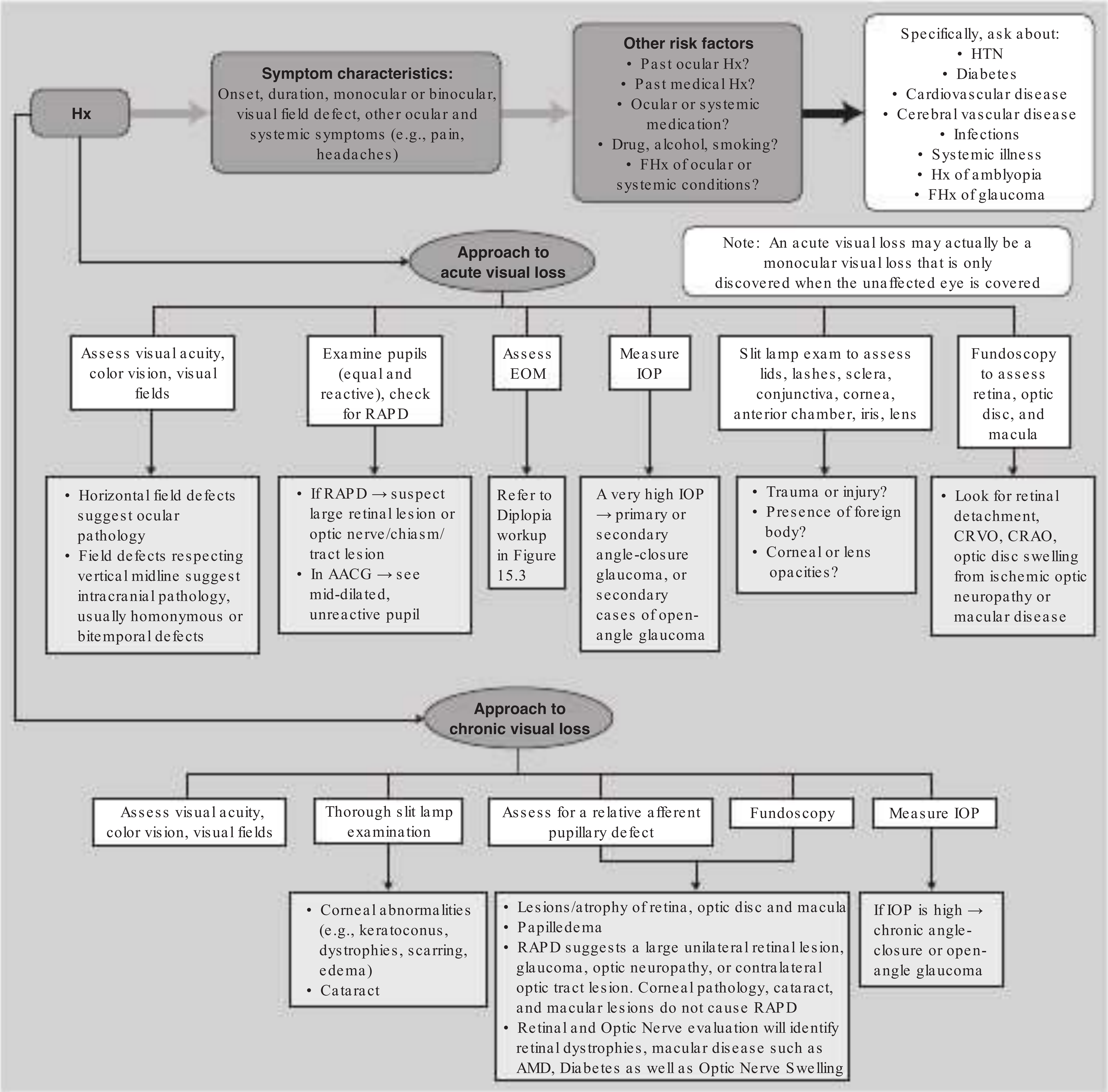

Hx
Symptom characteristics: Onset, duration, monocular or binocular, visual field defect, other ocular and systemic symptoms (e.g., pain, headaches)
Other risk factors
• Past ocular Hx?
• Past medical Hx?
• Ocular or systemic medication?
• Drug, alcohol, smoking?
• FHx of ocular or systemic conditions?
Specifically, ask about:
• HTN
• Diabetes
• Cardiovascular disease
• Cerebral vascular disease
• Infections
• Systemic illness
• Hx of amblyopia
• FHx of glaucoma
Approach to acute visual loss
Note: An acute visual loss may actually be a monocular visual loss that is only discovered when the unaffected eye is covered
Assess visual acuity, color vision, visual fields
Examine pupils (equal and reactive), check for RAPD
Assess EOM
Measure IOP
Slit lamp exam to assess lids, lashes, sclera, conjunctiva, cornea, anterior chamber, iris, lens
Fundoscopy to assess retina, optic disc, and macula
• Horizontal field defects suggest ocular pathology
• Field defects respecting vertical midline suggest intracranial pathology, usually homonymous or bitemporal defects
• If RAPD → suspect large retinal lesion or optic nerve/chiasm/tract lesion
• In AACG → see mid-dilated, unreactive pupil
Refer to Diplopia workup in Figure 15.3
A very high IOP → primary or secondary angle-closure glaucoma, or secondary cases of open-angle glaucoma
• Trauma or injury?
• Presence of foreign body?
• Corneal or lens opacities?
• Look for retinal detachment, CRVO, CRAO, optic disc swelling from ischemic optic neuropathy or macular disease
Approach to chronic visual loss
Assess visual acuity, color vision, visual fields
Thorough slit lamp examination
Assess for a relative afferent pupillary defect
Fundoscopy
Measure IOP
• Corneal abnormalities (e.g., keratoconus, dystrophies, scarring, edema)
• Cataract
• Lesions/atrophy of retina, optic disc and macula
• Papilledema
• RAPD suggests a large unilateral retinal lesion, glaucoma, optic neuropathy, or contralateral optic tract lesion. Corneal pathology, cataract, and macular lesions do not cause RAPD
• Retinal and Optic Nerve evaluation will identify retinal dystrophies, macular disease such as AMD, Diabetes as well as Optic Nerve Swelling
If IOP is high → chronic angle-closure or open-angle glaucoma

Figure 15.6. Approach to visual disturbance/loss: Hx and physical exam.

Important Clinical Features Associated with Decreased Vision

- Intermittent versus permanent visual loss
  - Duration of intermittent visual loss may be a helpful diagnostic clue: vision loss may last for seconds (e.g., transient visual obscurations from papilledema), minutes (e.g., migraine auras last 20–40 min; monocular vision loss from amaurosis fugax lasts between 5 and 15 min), or longer (CRAO from emboli from underlying carotid stenosis may be permanent).
- Rapidity of onset: acute (seconds to minutes in retinal ischemia), chronic (months to years in chronic glaucoma, may even be asymptomatic)
- Presence of pain (e.g., typical optic neuritis is associated with painful eye movements) or painless (retinal ischemia and chronic glaucoma are often painless)

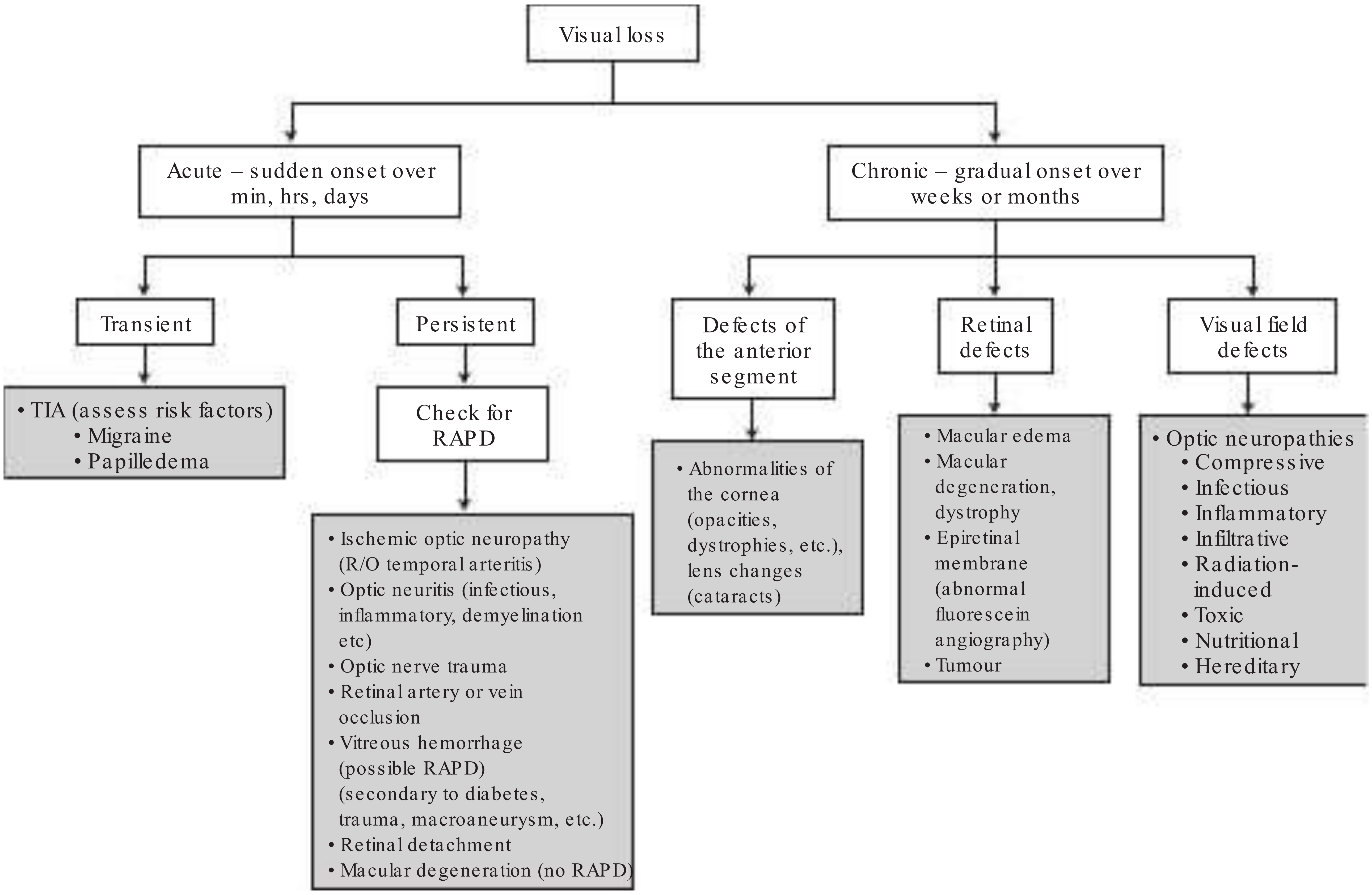

Visual loss
Acute – sudden onset over min, hrs, days
Chronic – gradual onset over weeks or months
Transient
Persistent
Defects of the anterior segment
Retinal defects
Visual field defects
• TIA (assess risk factors)
• Migraine
• Papilledema
Check for RAPD
• Ischemic optic neuropathy (R/O temporal arteritis)
• Optic neuritis (infectious, inflammatory, demyelination etc)
• Optic nerve trauma
• Retinal artery or vein occlusion
• Vitreous hemorrhage (possible RAPD) (secondary to diabetes, trauma, macroaneurysm, etc.)
• Retinal detachment
• Macular degeneration (no RAPD)
• Abnormalities of the cornea (opacities, dystrophies, etc.), lens changes (cataracts)
• Macular edema
• Macular degeneration, dystrophy
• Epiretinal membrane (abnormal fluorescein angiography)
• Tumour
• Optic neuropathies
• Compressive
• Infectious
• Inflammatory
• Infiltrative
• Radiation-induced
• Toxic
• Nutritional
• Hereditary

Figure 15.7. Approach to visual disturbance/loss.

VISUAL DISTURBANCES

Acute vision loss indicates a serious ophthalmic or neurologic condition and requires urgent investigation.

CLINICAL box

Clinical Correlates of Visual Defects

Bitemporal hemianopsia: pituitary adenoma, suprasellar meningioma, craniopharyngioma, and aneurysm of internal carotid artery are four most common lesions affecting optic chiasm.

CLINICAL box

Chronic Visual Loss

Chronic visual loss is often painless. After a normal ophthalmic exam including visual fields, slit lamp exam, color vision, and pupil exam, consider amblyopia as a cause, particularly if patient has anisometropia.

- Distribution: unilateral (involving one eye and its optic nerve) or bilateral (involving the intracranial visual pathway **or** involving both eyes or both optic nerves)

Occasionally, chronic monocular visual loss is only discovered (and described to the physician as acute onset) when the unaffected eye is covered.

CLINICAL box

Visual Acuity and Visual Field Testing

- Test each eye independently (cover the other eye)
- Always conduct testing with best corrected vision in place (e.g., with most recent corrective glasses)
- Use a pinhole over the eye to correct a component of refractive error
- Test both distance vision (Snellen chart) and near vision (pocket vision chart)
- Bring patient closer to the Snellen chart if he or she cannot read the E (20/400). Record the farthest distance that the patient can read the big "E." When unable to read the chart at distance of 3 ft, test the ability of patient to count fingers (note the farthest distance away from the patient, and record "CF"). Next, identify the ability to detect hand motions (check directions, and record "HM"), or perceive a bright light shone into the eye ("LP"). If unable to perceive light, record "NLP," or "no light perception."

Testing Visual Fields by Confrontation

- Test visual field by confrontation means comparing your visual field with that of your patient. The regions of impaired visual field help to localize the anatomic site of the lesion.
- Test each of the patient's eyes independently. Hold your fingers equidistant between yourself and the patient in all four quadrants. Ensure that the patient's fixation is upon your open eye and does not deviate during testing. You should be able to see your fingers using your peripheral vision while testing.

Investigations

Fluorescein Angiography

- To study blood flow in retina and choroid
- Sodium fluorescein is an orange colored dye, with a peak absorption of light of 465 to 490 nm wavelength and an emission peak of 520 to 530 nm.

- Fluorescein angiogram involves injecting fluorescein dye into a peripheral vein (typically antecubital vein); dye first enters the choroidal circulation, then the retinal circulation. Fundus photos of the circulation of the fluorescein through the choroid and retinal vasculature are taken by illuminating the fundus with a blue light (peak absorption of fluorescein), thereby exciting sodium fluorescein molecules to a higher energy state.
- Fluorescein molecules return to their resting state and emit yellow-green light. The photographic film detects only the yellow-green light.
- Retinal blood vessels are normally impermeable to dye due to tight junctions and form the inner blood–retina barrier; the retinal pigment epithelium forms the outer blood–retina barrier.
- Leakage of fluorescein dye from retinal vessels is abnormal. Other patterns of unusual fluorescence include staining (e.g., drusen in age-related macular degeneration), pooling of fluorescein in the subretinal space, blockage of normal fluorescence (from a media opacity, for instance, a preretinal hemorrhage), or a filling defect from absent perfusion of the retinal vasculature (e.g., in a branch retinal artery occlusion; see Table 15.13 and Figure 15.6).

tAbLe 15.13 • Fluorescein angiography indications

Diabetic retinopathy	• Distinguish between nonischemic vs. ischemic diabetic maculopathy • Detect and localize macular edema for laser treatment or injection of anti-VEGF medication
Renal vein occlusion	• Assess capillary bed in fovea, extent of capillary nonperfusion, and degree of macular edema due to venous occlusion • Distinguish collateral vessels from neovascularization
AMD	• Assess the type of choroidal neovascularization and need for injection of anti-VEGF medication
Other (depending on condition or suspicion)	• Identify choroidal neovascular membrane • Detect abnormal blood vessels or location of retinal fluid • Detect breakdown of RPE tight junction

PuPIL AbnOrMALItIeS

MCC ObjeCtIve

This topic is no longer an objective of the MCCQE Part 1. It has been included only for educational benefit.

OvervIew

Anisocoria

Condition in which the pupils have different sizes. Anisocoria is likely not physiologic if pupils differ in size by > 2 mm. Pupil size should be measured in both dark and bright light to identify which pupil is abnormal. The smaller pupil is abnormal if the anisocoria increases in dark. The larger pupil is abnormal if the anisocoria increases in bright light.

APPLIeD SCIentIfIC COnCePtS

Pathway of Pupillary Constriction (Figure 15.8)

Retinal ganglion cells convey visual information from the photoreceptors through the optic nerve, chiasm, and leave the optic tract for the pretectal nucleus of the midbrain. From the pretectal nucleus, axons connect to neurons in both Edinger-Westphal nuclei (bilateral innervation). Parasympathetic neurons course from the Edinger-Westphal nucleus to the ciliary ganglion in the orbit via the oculomotor nerve. Short ciliary nerves leave the ciliary ganglion to innervate the pupillary

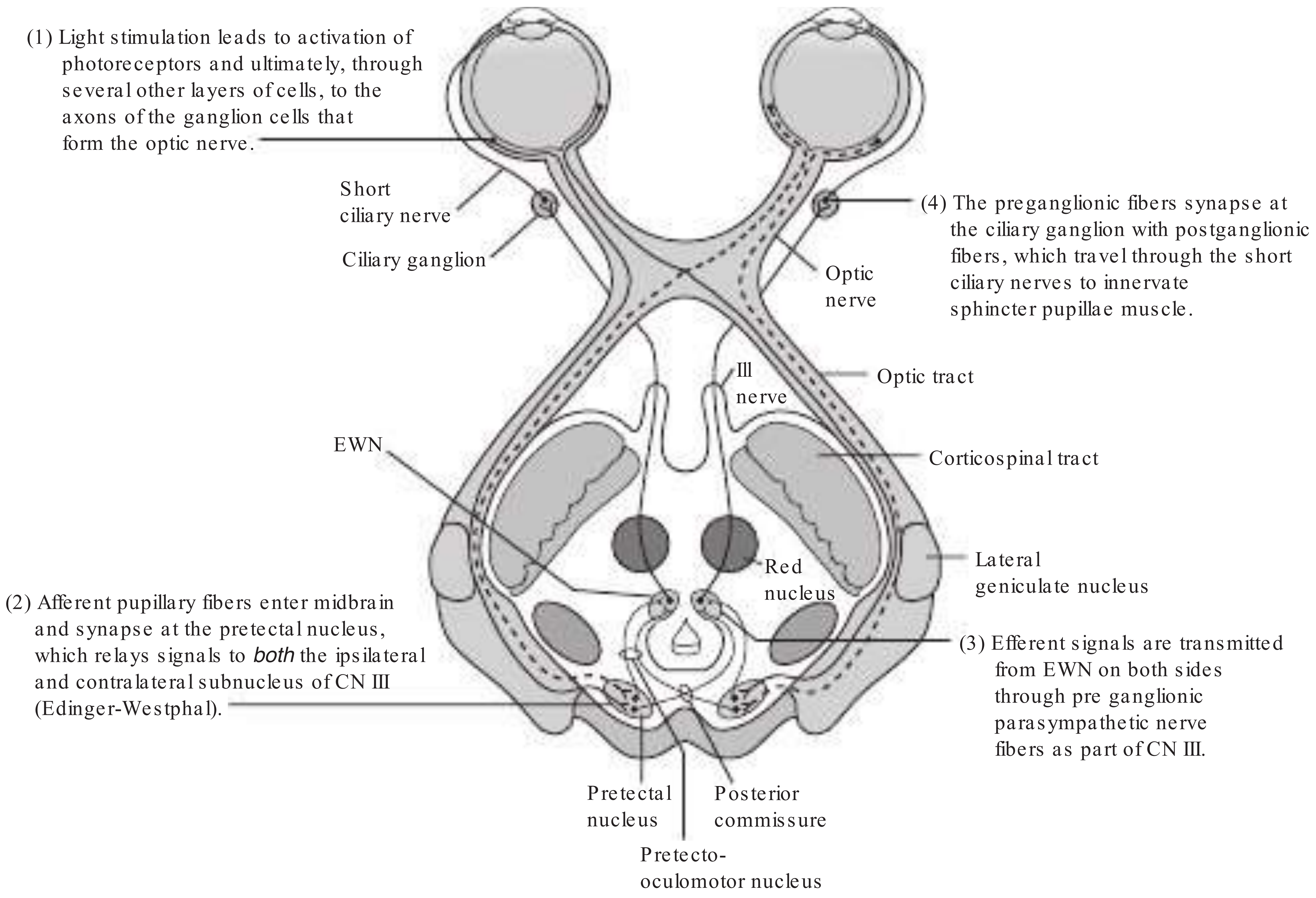

(1) Light stimulation leads to activation of photoreceptors and ultimately, through several other layers of cells, to the axons of the ganglion cells that form the optic nerve.
Short ciliary nerve
Ciliary ganglion
(4) The preganglionic fibers synapse at the ciliary ganglion with postganglionic fibers, which travel through the short ciliary nerves to innervate sphincter pupillae muscle.
Optic nerve
Optic tract
III nerve
EWN
Corticospinal tract
Red nucleus
Lateral geniculate nucleus
(2) Afferent pupillary fibers enter midbrain and synapse at the pretectal nucleus, which relays signals to *both* the ipsilateral and contralateral subnucleus of CN III (Edinger-Westphal).
(3) Efferent signals are transmitted from EWN on both sides through pre ganglionic parasympathetic nerve fibers as part of CN III.
Pretectal nucleus
Posterior commissure
Pretecto-oculomotor nucleus

Figure 15.8. Mechanism of pupillary constriction—afferent signals received in one eye cause efferent pupillary constriction in both eyes (direct and consensual responses).

sphincter muscle and cause pupillary constriction. Because of the bilateral innervation of the Edinger-Westphal nucleus, light shone in one eye will normally cause both pupils to constrict. The constriction response of the pupil in the eye being stimulated with light is the direct response. The constricting response in the contralateral eye is the consensual response.

CAUSAL CONDITIONS (Table 15.14)

TABLE 15.14 • Neurologic causes of abnormal pupil

	Causal Condition	Main Signs and Symptoms	Notes
Impaired pupil is smaller (dilator muscle is not functioning)—more anisocoria in dark.	Horner syndrome • Loss of sympathetic innervation • Central (1st order), preganglionic (2nd order), or postganglionic (3rd order) lesion	• Ptosis, miosis, anhidrosis • Dilation lag—slow dilation of the affected pupil • Reverse ptosis—inferior lid appears to be slightly elevated	• Many causes depending on location of lesion • 1st order: tumor, vascular, demyelination, trauma (MRI) • 2nd order: Pancoast tumor of lung apex, bony metastases, cervical fracture • 3rd order: carotid dissection, cavernous sinus lesion, neck compression, basal skull fracture (CT/CTA or MRI/MRA above heart to brain)

(Continued)

Table 15.14 • Continued

	Causal Condition	Main Signs and Symptoms	Notes
Impaired pupil is larger (pupillary sphincter is not working)—more anisocoria in light.	CN III palsy (DDx: Adie pupil, traumatic mydriasis, pharmacologic dilation)	• Ptosis, impaired elevation, adduction, infraduction, diplopia, pupil dilation • DDx for CN III includes: • Ischemic • Compressive lesion such as posterior communicating artery aneurysm, basilar artery aneurysm, orbital apex or cavernous sinus mass, uncal herniation (Hutchinson pupil) • Traumatic See Table 15.5	• Pupil is unreactive to weak cholinergic agents (0.125% Pilocarpine), but constricts to 1% Pilocarpine.

Relative Afferent Pupillary Defect

An RAPD is observed when light of identical intensity is perceived as being of different intensity when presented before each eye because of a lesion often affecting the optic nerve. This difference in perceived light intensity between the eyes accounts for the constriction of both pupils when light is shone into the eye perceiving normal light intensity and the abnormal dilation of both pupils when the light is shone into the eye perceiving a less intense light. This is appreciated clinically during the swinging light test.

DDx for RAPD (Figure 15.9)

- Large unilateral (or very asymmetrical) retinal lesions such as a retinal detachment, ischemic CRVO, CRAO. Maculopathies do not usually cause a significant RAPD.

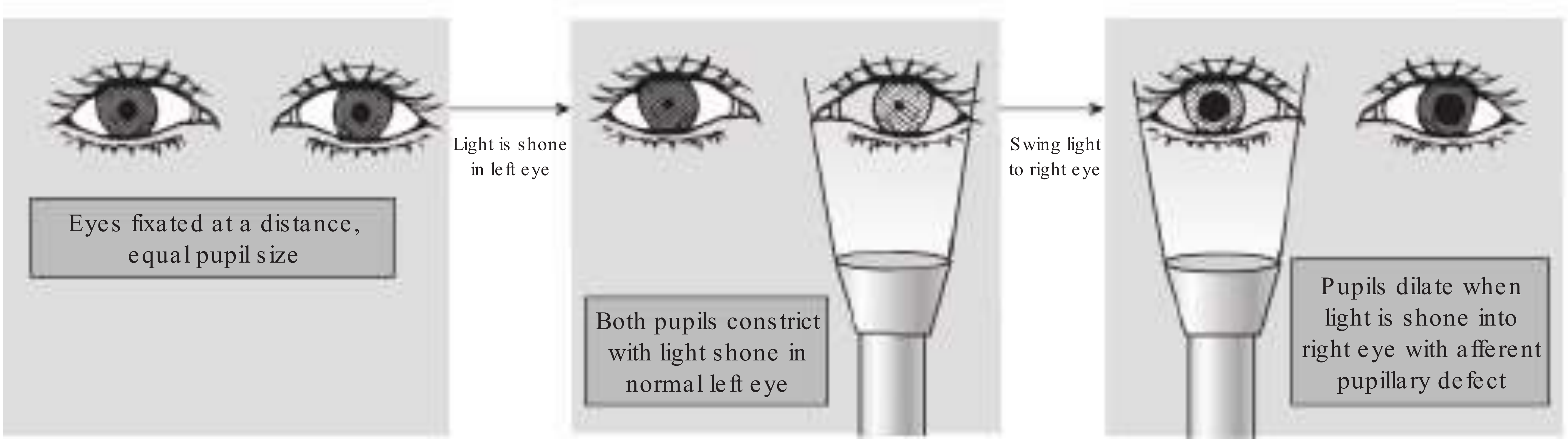

Eyes fixated at a distance, equal pupil size
Light is shone in left eye
Both pupils constrict with light shone in normal left eye
Swing light to right eye
Pupils dilate when light is shone into right eye with afferent pupillary defect

Figure 15.9. RAPD in right eye using a swinging flashlight test.

- All unilateral or asymmetric optic neuropathies classically present with RAPD: glaucoma, arteritic (GCA) and nonarteritic ischemic optic neuropathies, infiltrative, inflammatory, compressive (e.g., optic nerve meningioma or glioma), radiation optic neuropathy, optic neuritis from demyelination, etc.
- An optic tract lesion may cause a contralateral RAPD because of the asymmetric crossing of fibers. A slightly greater number of fibers from the right retina cross at the chiasm to supply the left lateral geniculate nucleus (via the optic tract) than fibers arriving from the left retina. Thus, a left optic tract lesion will present with a right RAPD.
- Of note, cataract and amblyopia are two important conditions that do **not** classically cause an RAPD.

Other Pupillary Abnormalities: Light-Near Dissociation

Pupils do not constrict briskly to light, but constrict more strongly to a near stimulus (when tested as part of the near triad of convergence, accommodation, and pupillary constriction).

Differential for Light-Near Dissociation

- Bilateral severe vision loss
  - Patient with bilateral severe vision loss from any disease affecting the anterior visual pathway (retina, optic nerve, chiasm) will have impaired pupillary constriction to light but will have intact pupillary constriction to (sometimes imagined) near stimuli.
- Argyll Robertson pupils (neurosyphilis)
  - Bilateral, small, irregular pupils
  - Investigations: VDRL, FTA-ABS, CSF analysis
- Dorsal midbrain syndrome (also known as Parinaud syndrome)
  - Lesion compresses the dorsal midbrain, affecting pupillomotor fibers, but spares the more ventral fibers responsible for the near response.
  - Most likely structural lesion varies with age (in infancy and childhood—congenital aqueductal stenosis, pineal germinoma; adults: trauma, brainstem vascular malformations, demyelination).
  - In addition to dilated tonic pupils, dorsal midbrain syndrome may present with other ocular findings such as limited upgaze, eyelid retraction, convergence-retraction nystagmus, and skew deviation.
- **Tonic pupil** results from damage to the parasympathetic fibers of the ciliary ganglion
  - Four major causes:
    - Local process involving the ciliary ganglion such as sarcoidosis, orbital tumor, trauma, temporal arteritis, or surgery
    - Neuropathic: diabetes, alcoholism, Guillain-Barré, familial dysautonomia
    - Infectious: neurosyphilis, HZV, HSV
- Adie tonic pupil
  - Often seen in young (20–40s) females (70%). Unilateral in 80% of cases, but becomes bilateral at a rate of 4%/yr, usually asymptomatic, but patient may complain of difficulty reading.
  - Lesion is thought to involve ciliary ganglion or short ciliary nerves. Because the efferent parasympathetic fibers leaving the ciliary ganglion serving accommodation (~97%) are more numerous than those serving pupillary constriction (~3%), lesions of the ciliary ganglion may relatively spare pupillary constriction to accommodation while impairing pupillary constriction to light.
  - Affected pupil is initially dilated (from reduced parasympathetic innervation) and becomes smaller with time ("little old Adie's").
  - Features of Adie pupil include light-near dissociation, sectoral palsy of iris causing vermiform movements, slow and tonic redilation after constriction to near stimulus, reduced accommodation (may need bifocals).
  - Cholinergic denervation supersensitivity occurs after days to weeks and may be demonstrated by pupillary constriction after instilling dilute pilocarpine (0.125%), which will not constrict normal pupil or the dilated pupil of a 3rd nerve palsy

Horner Syndrome !

Acute Horner syndrome (ptosis, miosis, may have anhidrosis) demands an immediate workup to exclude life-threatening causes such as internal carotid artery dissection, Pancoast tumor, or brainstem infarction. In a child, Horner syndrome may represent a serious malignancy along the sympathetic chain such as neuroblastoma.

APPROACH (Figure 15.10)

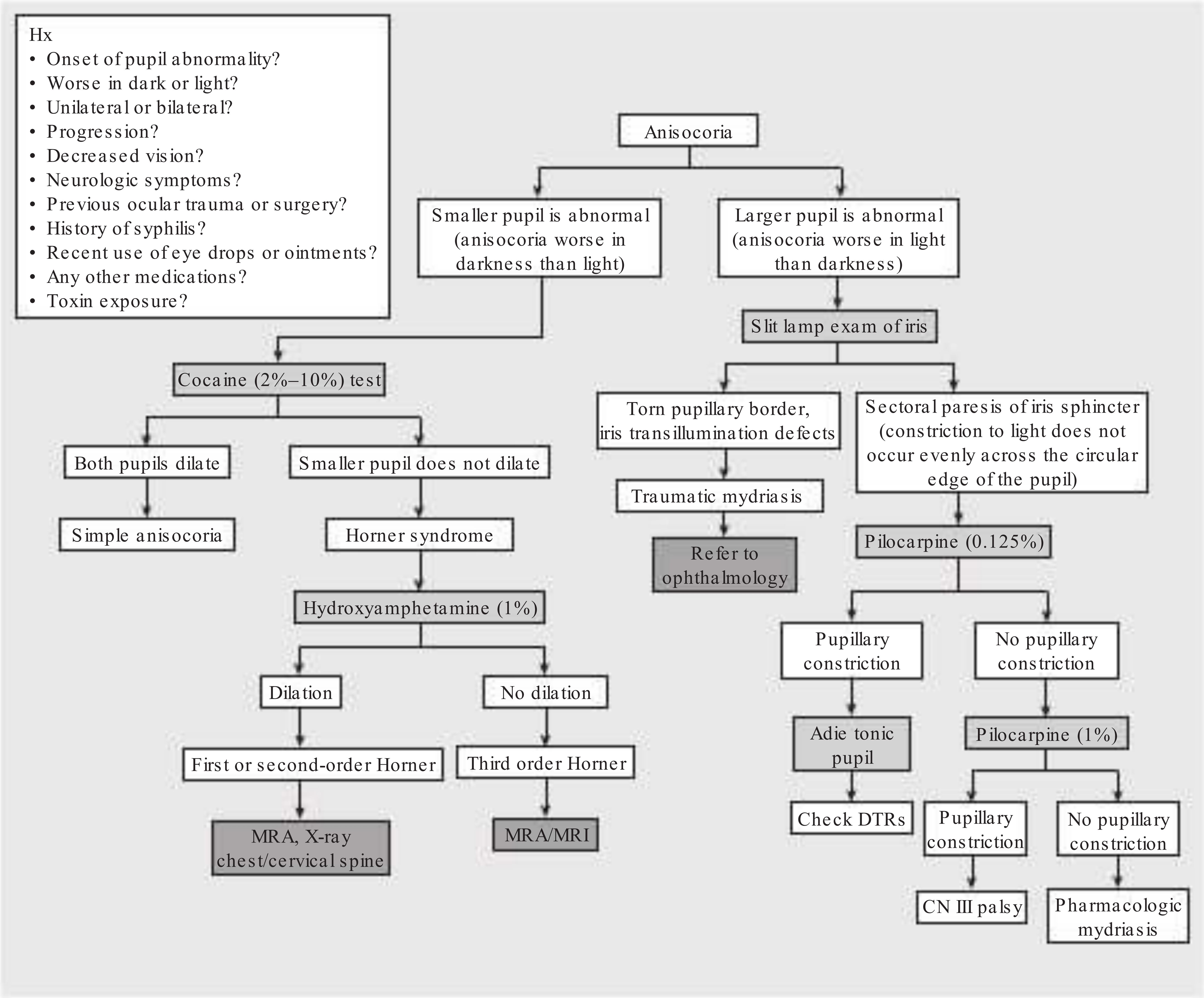
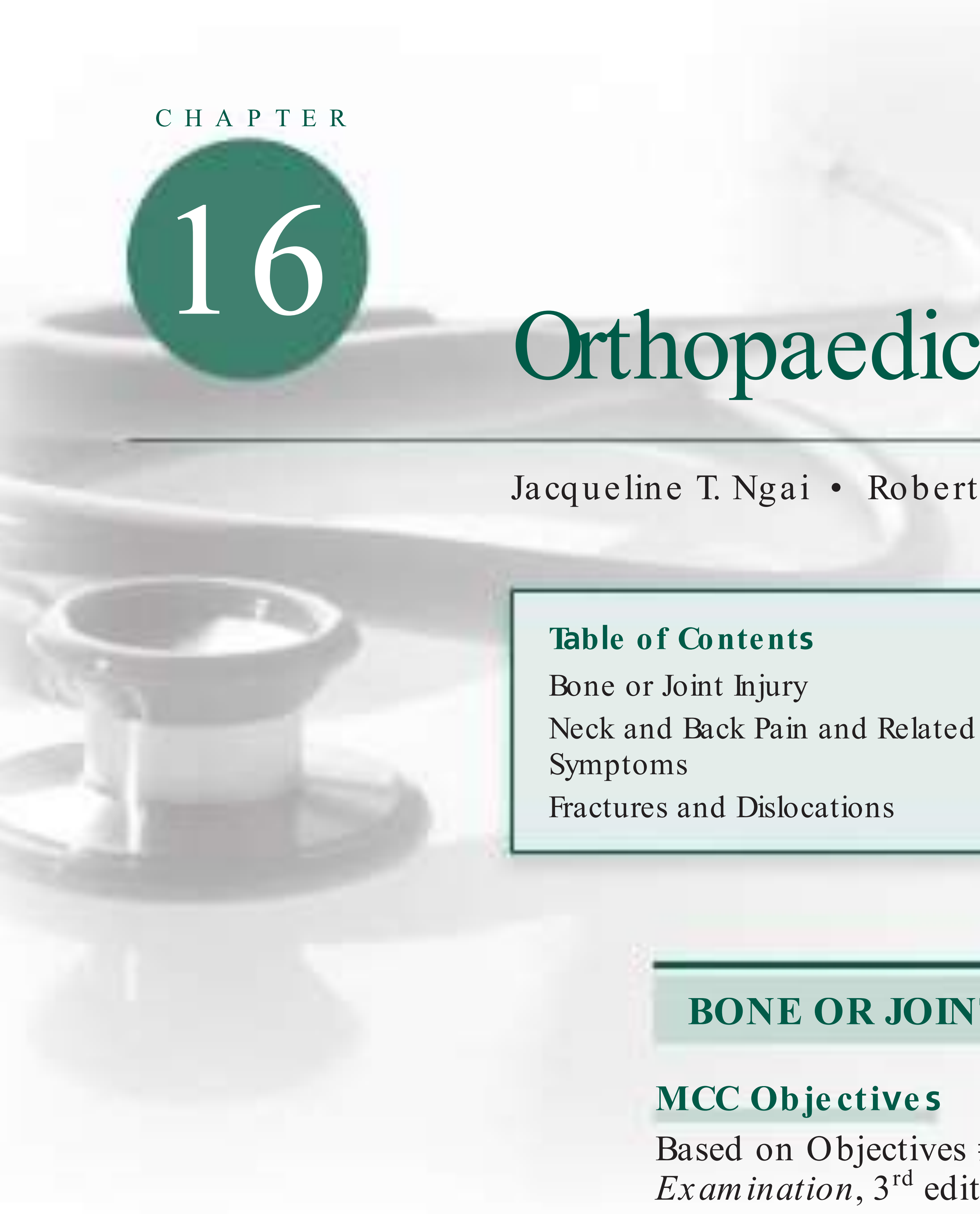

Hx
• Onset of pupil abnormality?
• Worse in dark or light?
• Unilateral or bilateral?
• Progression?
• Decreased vision?
• Neurologic symptoms?
• Previous ocular trauma or surgery?
• History of syphilis?
• Recent use of eye drops or ointments?
• Any other medications?
• Toxin exposure?
Anisocoria
Smaller pupil is abnormal (anisocoria worse in darkness than light)
Larger pupil is abnormal (anisocoria worse in light than darkness)
Cocaine (2%–10%) test
Both pupils dilate
Simple anisocoria
Smaller pupil does not dilate
Horner syndrome
Hydroxyamphetamine (1%)
Dilation
First or second-order Horner
MRA, X-ray chest/cervical spine
No dilation
Third order Horner
MRA/MRI
Slit lamp exam of iris
Torn pupillary border, iris transillumination defects
Traumatic mydriasis
Refer to ophthalmology
Sectoral paresis of iris sphincter (constriction to light does not occur evenly across the circular edge of the pupil)
Pilocarpine (0.125%)
Pupillary constriction
Adie tonic pupil
Check DTRs
No pupillary constriction
Pilocarpine (1%)
Pupillary constriction
CN III palsy
No pupillary constriction
Pharmacologic mydriasis

Figure 15.10. Approach to anisocoria.



CHAPTER

16

Orthopaedic Surgery

Jacqueline T. Ngai • Robert J. Feibel*

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Bone or Joint Injury
Neck and Back Pain and Related Symptoms
Fractures and Dislocations
Hand and Wrist Injuries
Spinal Trauma
Limp in Children

BONE OR JOINT INJURY

MCC Objectives

Based on Objectives #109-3 (Bone or Joint Injury) of *Objectives for the Qualifying Examination*, 3rd edition. Please also see sections on Fractures and Dislocations (Objective #109-16; Chapter 16), Back Pain and Related Symptoms (Objective #50-4; Chapter 16), Neck Pain (Objective #50-5; Chapter 16), Spinal Trauma (Objective #109-13; Chapter 16), Hand and/or Wrist Injuries (Objective #109-9; Chapter 16), Oligoarthralgia (Objective #50-1; Chapter 22), Polyarthralgia (Objective #50-2; Chapter 22), and Nonarticular Musculoskeletal Pain (Objective #50-3; Chapter 22).

OVERVIEW

- Acute pain or deformity in the spine or extremities can be caused by injuries to bones or joints.
- Assessment is needed to determine whether the condition is benign and self-limiting or if it requires additional investigation and treatment.
- Many conditions can be managed by primary care physicians and do not need referral.
- Remember to rule out nonaccidental injuries

CAUSAL CONDITIONS (Table 16.1)

TABLE 16.1 • Nonexhaustive list of differential diagnoses for bone or joint pain

Causal Conditions	Examples
Trauma	Fractures Dislocations Meniscal tears Nonaccidental injuries (domestic violence, child abuse)
Degeneration	OA
Inflammation	RA Ankylosing spondylitis Psoriatic arthritis
Infection	Septic arthritis Osteomyelitis Granulomatous infection
Repetitive strain	Stress fracture Bursitis

(Continued)

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*With contributions from: Dr. Stephen Kingwell; Dr. Jacob Karsh; Dr. Niloofar Dehghan

TABLE 16.1 • Continued

Causal Conditions	Examples
Neoplastic	Primary lesions Metastatic lesions
Metabolic	Crystal arthropathy (CPPD, gout) Osteoporotic fractures
Vascular	AVN Vascular insufficiency DVT
Musculotendinous	Strain, sprain, or rupture
Referred pain	

APPROACH

History

- *Pain*: location, onset, alleviating or aggravating factors, quality, radiation, severity. Timing (chronic vs. acute). Any night pain (more concerning).
- *Neurovascular symptoms*: any numbness, weakness, pallor, or cool limb
- Any history of trauma? If so, mechanism of injury and which sites injured.
- Any history of recurrent falls? If so, ask about fall risks (e.g., use of ambulatory aids, tripping hazards, previous fragility fractures) and comorbidities making falls more likely (e.g., syncope, arrhythmias, Parkinson's, dementia, poor vision).
- Previous treatments and whether they were effective
- Functional impact of symptoms on patient. Handedness for any upper extremity injuries.
- Screen for abuse (e.g., inconsistent history, unlikely injury given mechanism or child's developmental stage)
- Medical history, medications, allergies, social history (including employment, living situation, substance use history, or other factors that will influence recovery from injury)

Physical Exam

- General musculoskeletal exam includes:
  - *Inspection*: deformity, swelling, bruising, erythema, muscle atrophy
  - *Palpation*: check for tenderness, effusion, warmth, palpable deformity, crepitus
  - *ROM*: Active and passive ROM. Include joint above and below affected area.
  - *Neurovascular exam*: check sensation in peripheral nerve distributions, pulses, capillary refill
  - *Special tests*:
    - *Neck and back*: see sections on Neck and Back Pain
    - *Shoulder*: apprehension and sulcus sign (shoulder instability), painful arc, Hawkins and Neer tests (impingement), AC compression (AC degeneration), Yergason test Speed test (biceps instability or tendinopathy), specific testing for rotator cuff muscles, including the "empty can test" and "lift off test"
    - *Elbow*: varus and valgus stress testing (instability), resisted wrist/forearm flexion and extension (medial and lateral epicondylitis)
    - *Wrist and hand*: see section on Hand and Wrist Injuries
    - *Hip and pelvis*: Trendelenburg gait and sign (abductor weakness), Thomas test (flexion contracture), FABER (for **F**lexion, **AB**duction, **E**xternal **R**otation, and **E**xtension) test (SI joint), limb length discrepancy
    - *Knee*: anterior and posterior drawer tests, Lachman test (anterior/posterior instability), McMurray test (meniscal injury), dial test (PCL/PLC injury), varus and valgus stress testing (medial/lateral instability)
    - *Foot and ankle*: anterior drawer (instability), Thompson test (Achilles tendon rupture), windlass test (plantar fasciitis)

Investigations

Laboratory Investigations

- Will depend on differential diagnosis:
  - *Infectious*: CBC, CRP, ESR, blood cultures
  - *Inflammatory*: rheumatologic workup

Imaging

- X-rays: fractures/dislocations
- CT: provides more information on bony injuries
- MRI: better for soft tissue, meniscal, ligamentous injuries
- Bone scan: occult fractures, stress fractures, malignant lesions, osteomyelitis

Invasive Investigations

- Joint aspiration: for crystal arthropathy or septic arthritis
- Bone culture: for osteomyelitis
- Bone biopsy: for neoplastic lesions
- Nerve conduction studies: if suspect nerve injury causing symptoms

Management

- Will depend on etiology. Management may include immobilization, restricted weight-bearing, analgesia, or specialist referral. May need referral to a physiotherapist or occupational therapist during recovery.
- Ensure follow-up to monitor for recovery, continued need for activity modification or immobilization, safe return to work or regular activity, and any further complications
- Refer to falls prevention program, if indicated
- If abuse is suspected, contact child protective services as required by local regulations

NECK AND BACK PAIN AND RELATED SYMPTOMS

MCC Objectives

Based on Objectives #50-5 (Neck Pain) and #50-4 (Back Pain and Related Symptoms (e.g., Sciatica) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Neck and back pain are common and can be caused by many conditions. Some of these conditions are benign and self-limiting; others require investigation and treatment.
- Often cause work absence and can have significant functional impact on patients
- 10% to 15% of adults experience an episode of mild to moderate low back pain each year.
- 90% recover, but 10% go on to have chronic back pain.

APPLIED SCIENTIFIC CONCEPTS

- 33 vertebrae: 7 cervical, 12 thoracic, 5 lumbar, 5 sacral, 4 coccygeal
- Most neck flexion-extension is through atlanto-occipital joint.
- Most neck rotation is through C1 to C2.

CAUSAL CONDITIONS (Table 16.2)

TABLE 16.2 • Causal conditions for neck and back pain

Category	Conditions
Muscular	Muscle spasm/sprain Whiplash Myofascial pain syndrome
Spinal pathology	Fractures Arthritis (RA, OA, ankylosing spondylitis) Disc herniation Spinal stenosis Cauda equina Spondylosis Neoplasm (primary or metastatic) Infection (osteomyelitis, soft tissue) SI joint inflammation Scoliosis
Nonspinal pathology	Referred pain from GI, GU, AAA, renal colic

Muscular

- Muscle spasm/strain:
  - Can be related to poor posture
  - No neurologic deficit
  - Pain, stiffness, tightness in upper back, shoulders, neck
- Whiplash:
  - Due to abrupt flexion-extension movement
  - Can involve injury to soft tissues, ligaments, bony structures, discs
  - Symptoms can include occipital headache along with neck pain and loss of ROM.
  - Imaging may be normal.

Spine Pathology (Table 16.3)

TABLE 16.3 • Definitions relating to spine pathology

Spondylolysis	• Stress fracture in pars interarticularis • Caused by hyperextension/rotation • Common in young athletes (e.g., gymnasts, wrestlers)
Spondylolisthesis	• Anterior or posterior slippage of a vertebra relative to the vertebra below
Spinal stenosis	• Narrowing of spinal canal
Disc herniation	• Herniation of vertebral disc, causing compression/irritation to adjacent nerve roots

- Fractures:
  - See section on Spine Trauma
- Cervical radiculopathy:
  - 70% due to degenerative changes in spine, causing nerve root compression
  - Symptoms include radiating pain down arm, dermatomal sensory loss, and myotomal muscle weakness.
  - Treatment: rest, activity modification, nerve root steroid injections, analgesia (NSAIDs, GABA inhibitors). May need discectomy ± fusion.
- Lumbar radiculopathy (= sciatica):
  - Caused by compression of nerve root by herniated disc
  - Back pain is associated with leg pain along distribution of irritated nerve. Pain is burning, electrical, and shooting.
- Inflammatory back pain:
  - Typically worse with rest and better with activity, severe morning stiffness lasting for hours
  - Includes ankylosing spondylitis, psoriatic arthritis, reactive arthritis, enteropathic arthritis
- Infections:
  - Risk factors include being immunocompromised, IV drug use, TB exposure, age.
  - Can be discitis, osteomyelitis, or epidural abscess
  - Usually from hematogenous spread
  - Pain (can wake patient from sleep) may be associated with fever or neurologic deficits.
- Cauda equina syndrome:
  - Caused by compression of nerve bundle extending from bottom of spinal cord
  - Compression can be caused by ruptured or herniated disc, tumor, or abscess.
  - Back pain associated with saddle anesthesia, bladder or bowel symptoms (incontinence or retention). See Red Flag Box, Signs and Symptoms of Cauda Equina.
  - A surgical emergency!
- Malignancy:
  - Can be primary or metastatic
  - Common metastases to spine include breast, prostate, lung, renal, thyroid.

!

SignS and SymptomS of Cauda Equina

Saddle anesthesia

Loss of voluntary bladder and bowel functional

Bilateral radicular pain, loss of sensation, weakness

Hypo/areflexia

APPROACH

History (See Clinical Box, Red Flag Symptoms on History)

CLINICAL box

Red Flag Symptoms on History

Red flag Symptoms

- Acute onset localized back pain
- Night pain that wakes patient
- Malignancy history
- Progressive neurologic deficit
- Immunosuppression
- Constitutional symptoms
- Fever
- History of trauma
- Bladder or bowel symptoms
- Saddle anesthesia
- Motor weakness
- Point vertebral tenderness

- *Pain*: location, onset, alleviating or aggravating factors, quality, radiation, severity. Timing (chronic versus acute). Any night pain (more concerning).
- *Neurologic symptoms*: numbness, weakness, tingling, clumsiness, or changes in gait. Any radiation down legs.
- *Trauma*: history of trauma? Previous back injuries? Workplace injury?
- *Infectious symptoms:* fever/chills
- *Constitutional symptoms*: fever, night sweats, unexplained weight loss
- *Cauda equina*: saddle anesthesia, bowel or bladder symptoms (see Red Flag Box, Signs and Symptoms of Cauda Equina)
- Functional impact on patient
- Any previous investigations and results of investigations. Previous treatment/management and their effectiveness.
- *Medical history*: inflammatory conditions, previous injuries, history of malignancy, osteoporosis, IV drug use
- *Social history*: occupation, recreational activities, smoking

Physical Exam

- *Inspection*: posture, gait (heel and toe walk, tandem walk), muscle wasting
- *Palpation*: tenderness, step-off along spine
- ROM
- *Neurologic exam*: strength and sensation for dermatomes and myotomes, deep tendon reflexes, DRE for anal tone
- *Special tests:* straight leg raise (for nerve root irritation), femoral stretch, occiput to wall distance (anything above zero suggests osteoporotic degeneration), Schober test (assesses amount of movement in lumbar spine)

Investigations

Laboratory Investigations

- Consider inflammatory workup or infectious workup as appropriate

Imaging

- X-rays: good for bony pathology. In a trauma setting, use Canadian C-spine rules to determine whether imaging is needed (Figure 16.1).
- CT and MRI: if neurologic findings. MRI is also good for disc and cord pathology, infections, and neoplasm.

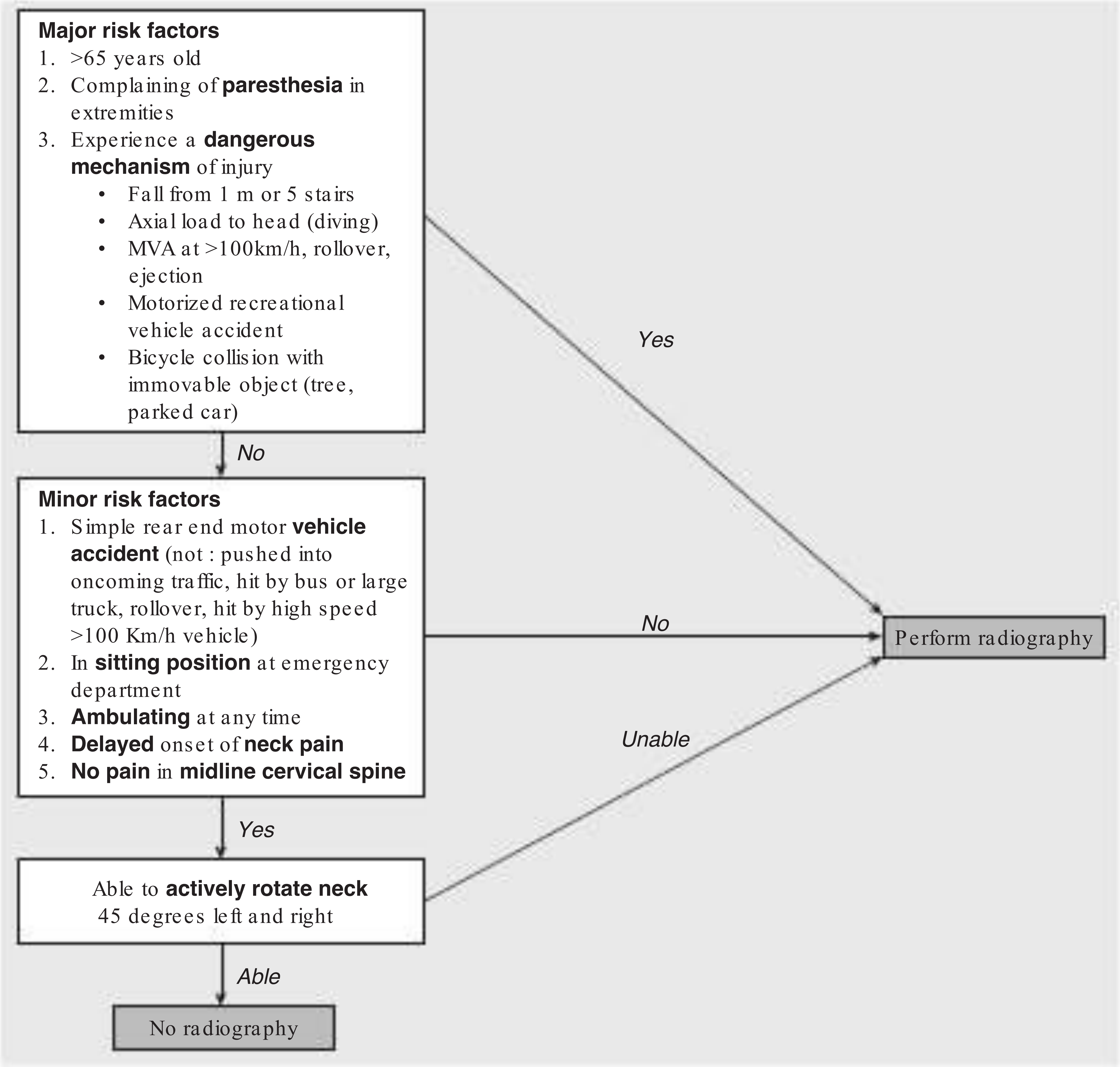

Major risk factors
1. >65 years old
2. Complaining of **paresthesia** in extremities
3. Experience a **dangerous mechanism** of injury
• Fall from 1 m or 5 stairs
• Axial load to head (diving)
• MVA at >100km/h, rollover, ejection
• Motorized recreational vehicle accident
• Bicycle collision with immovable object (tree, parked car)
Yes
No
Minor risk factors
1. Simple rear end motor **vehicle accident** (not : pushed into oncoming traffic, hit by bus or large truck, rollover, hit by high speed >100 Km/h vehicle)
2. In **sitting position** at emergency department
3. **Ambulating** at any time
4. **Delayed** onset of **neck pain**
5. **No pain** in **midline cervical spine**
No
Perform radiography
Unable
Yes
Able to **actively rotate neck** 45 degrees left and right
Able
No radiography

figure 16.1. Canadian C-spine rules.

Diagnosis (Figure 16.2)

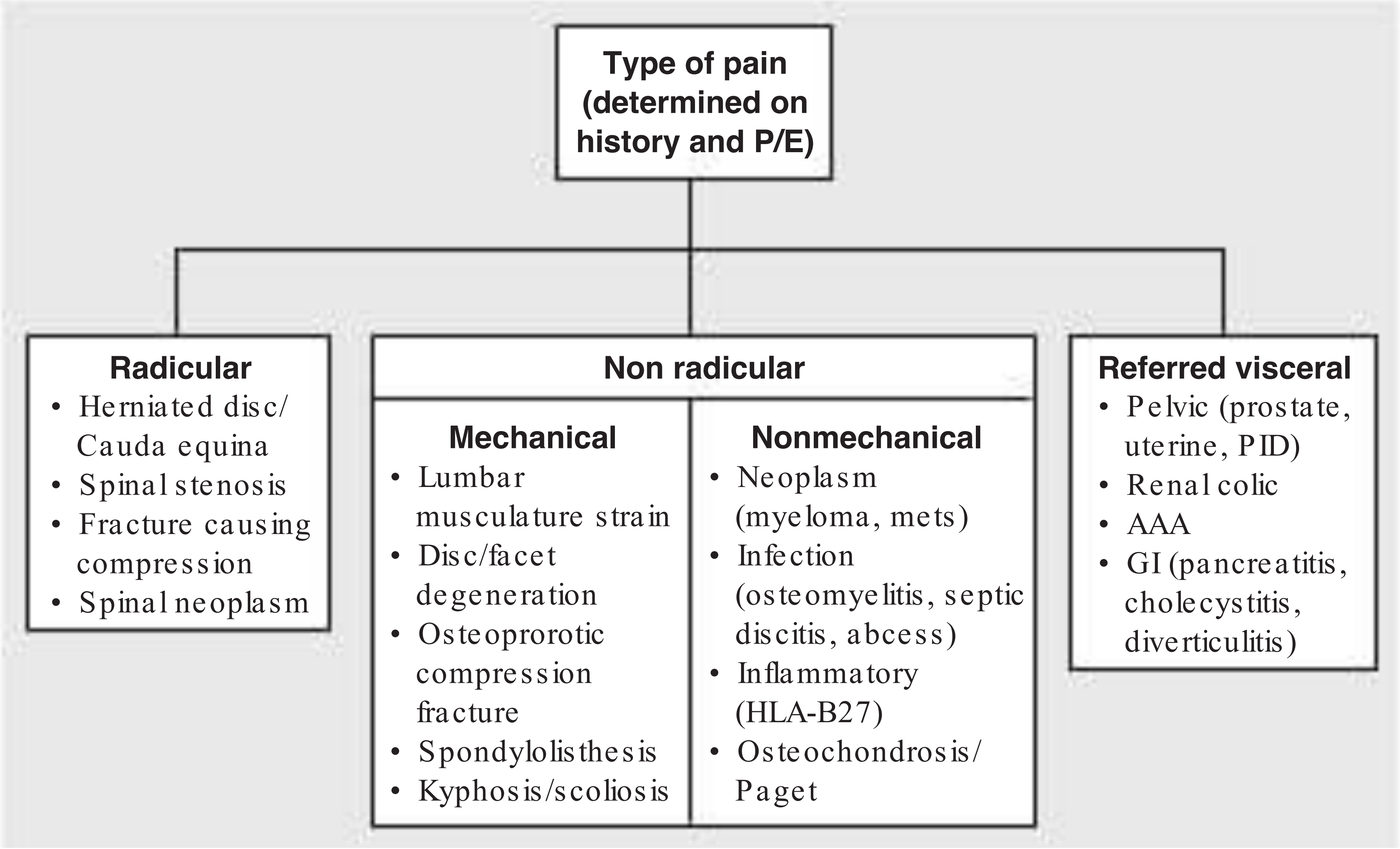

Type of pain (determined on history and P/E)
Radicular
• Herniated disc/ Cauda equina
• Spinal stenosis
• Fracture causing compression
• Spinal neoplasm
Non radicular
Mechanical
• Lumbar musculature strain
• Disc/facet degeneration
• Osteoprorotic compression fracture
• Spondylolisthesis
• Kyphosis/scoliosis
Nonmechanical
• Neoplasm (myeloma, mets)
• Infection (osteomyelitis, septic discitis, abcess)
• Inflammatory (HLA-B27)
• Osteochondrosis/ Paget
Referred visceral
• Pelvic (prostate, uterine, PID)
• Renal colic
• AAA
• GI (pancreatitis, cholecystitis, diverticulitis)

figure 16.2. Approach to lower back pain.

Management

- 90% of back pain resolves within a year.
- Treatment will depend on etiology and may require specialist referral.
- Mechanical low back pain usually resolves within a few weeks. Treatment can consist of:
  - Activity modification
  - NSAIDs and muscle relaxants
  - Massage, support garments, acupuncture
  - Physiotherapy for accessory muscle strengthening

FRACTURES AND DISLOCATIONS

MCC Objective

Based on Objective #109-16 (Fractures and Dislocations) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Fractures can be associated with dislocations or subluxations:
  - Dislocation: complete loss of contact between articular surfaces of a joint
  - Subluxation: incomplete dislocation
- Dislocations/subluxations can also occur independently and cause abnormal forces on the joint surface.
- Open fracture = soft tissue wound penetrates to fracture site.
- Remember to rule out abuse or other nonaccidental injuries! A recent study found that 1 in 6 women attending a fracture clinic had a history of intimate partner violence in the past year.

APPLIED SCIENTIFIC CONCEPTS

- Secondary fracture healing occurs in overlapping stages:
  - **Hematoma**: caused by bleeding from bone and soft tissue
  - **Inflammation**: hematopoietic cells produce growth factors. Fibroblasts, mesenchymal cells, and osteoprogenitor cells are recruited to the fracture site
  - **Callus**: from the action of osteoblasts and osteoclasts in fracture site. Bridging soft callus forms (weeks) and gradually becomes replaced by woven bone (hard callus)
  - **Remodeling**: lamellar bone replaces woven bone (weeks to years). Responds to mechanical stress through the bone (Wolff's Law).
- Remember that primary bone healing is seen with rigid internal fixation such as that with plate and screw fixation. Primary bone healing begins with the remodeling process. If external callus is evident and the patient continues to have pain, the fixation may be loose and aseptic or septic nonunion should be considered.
- Rate of fracture healing depends on:
  - **Biologic factors:** blood supply, soft tissue coverage, patient age and comorbidities, nutritional status, smoking, amount of bone loss, neurovascular status
  - **Mechanical factors:** stability, amount of comminution

CAUSAL CONDITIONS

Traumatic Fractures

- Traumatic fractures = normal bone + abnormal force

Stress Fractures

- Stress fractures = normal bone + repetitive force
- Risk factors: vibration, overloading, repetitive activities, posture

Pathologic Fractures

- Pathologic fractures = abnormal bone + normal force
- Caused by:
  - *Generalized bone disease*: Paget disease, metabolic bone disease (osteoporosis, hyperparathyroidism, osteomalacia), alcohol use, poor nutritional status

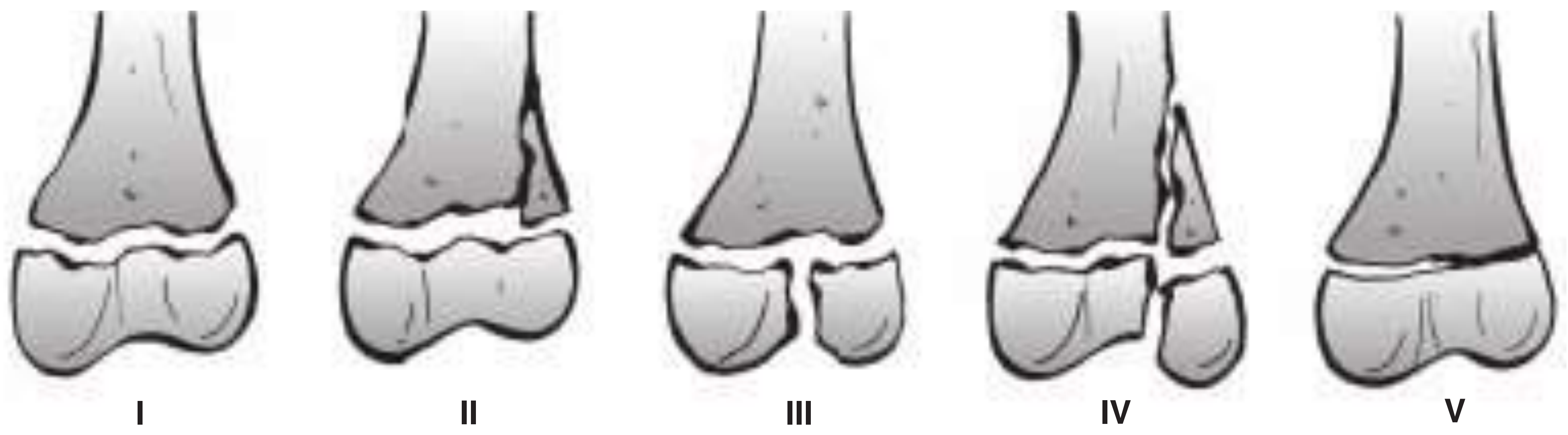
- *Local disease*: infection (e.g., TB), bone cyst
- *Malignancies*: primary (sarcoma or multiple myeloma) or metastatic (typically from breast, lung, prostate, renal, and thyroid)

Fragility Fractures

- Defined as fractures occurring after a fall from standing height or less, or in the absence of trauma
- Associated with low bone density
- Most commonly occur in the distal radius, hip, and spine
- Considered a risk factor for future fractures. Appropriate management can reduce the risk of future fractures and long-term disability associated with these injuries.

Pediatric Fractures

- Pediatric fractures around a growth plate are described according to the Salter-Harris classification (Figure 16.3).



I = Physis
II = **M**etaphysis
III = **E**piphysis
IV = **ME** (Metaphysis + Epiphysis) **M**+**E = ME**
V = Crush

figure 16.3. Salter-Harris classification.

- Greenstick fractures are unique to children. These fractures are described as a fracture on one side of the bone and a plastic deformation on the other side of the bone (i.e., both cortices are not broken).
- If the fracture disrupts the growth plate, there is risk of growth deformities or growth arrest.
- Many fractures can be treated with closed reduction, casting, and close follow-up with an orthopaedic surgeon.

APPROACH (Figure 16.4)

History

- *Trauma*: mechanism of trauma, high- or low-energy mechanism, other injuries (e.g., head injury after a fall), ability to weight bear after injury, open injuries, possible contamination, timing of injury. If open injury, ensure you ask about tetanus vaccination status.
- *Pain*: location, onset, alleviating or aggravating factors, quality, radiation, severity
- *Neurologic status*: any sensory changes after injury
- Risk factors for repetitive stress injuries
- *Constitutional symptoms*: fever, night sweats, unexplained weight loss
- Baseline functional status and mobility. Handedness for upper extremity injuries.
- Any previous investigation and results of investigations. Previous treatment/management and whether it helped with symptoms.
- *Medical history*: comorbidities that would impair healing (e.g., diabetes, neuropathy, renal disease, vascular disease), malignancy history, osteoporosis history, previous injuries to that limb, previous fractures, corticosteroid use
- *Social history*: occupation, recreational activities, smoking, alcohol use, possibility of abuse. Substance abuse can be a contributing factor in these injuries.
- When the patient last ate/drank if conscious sedation or OR planned

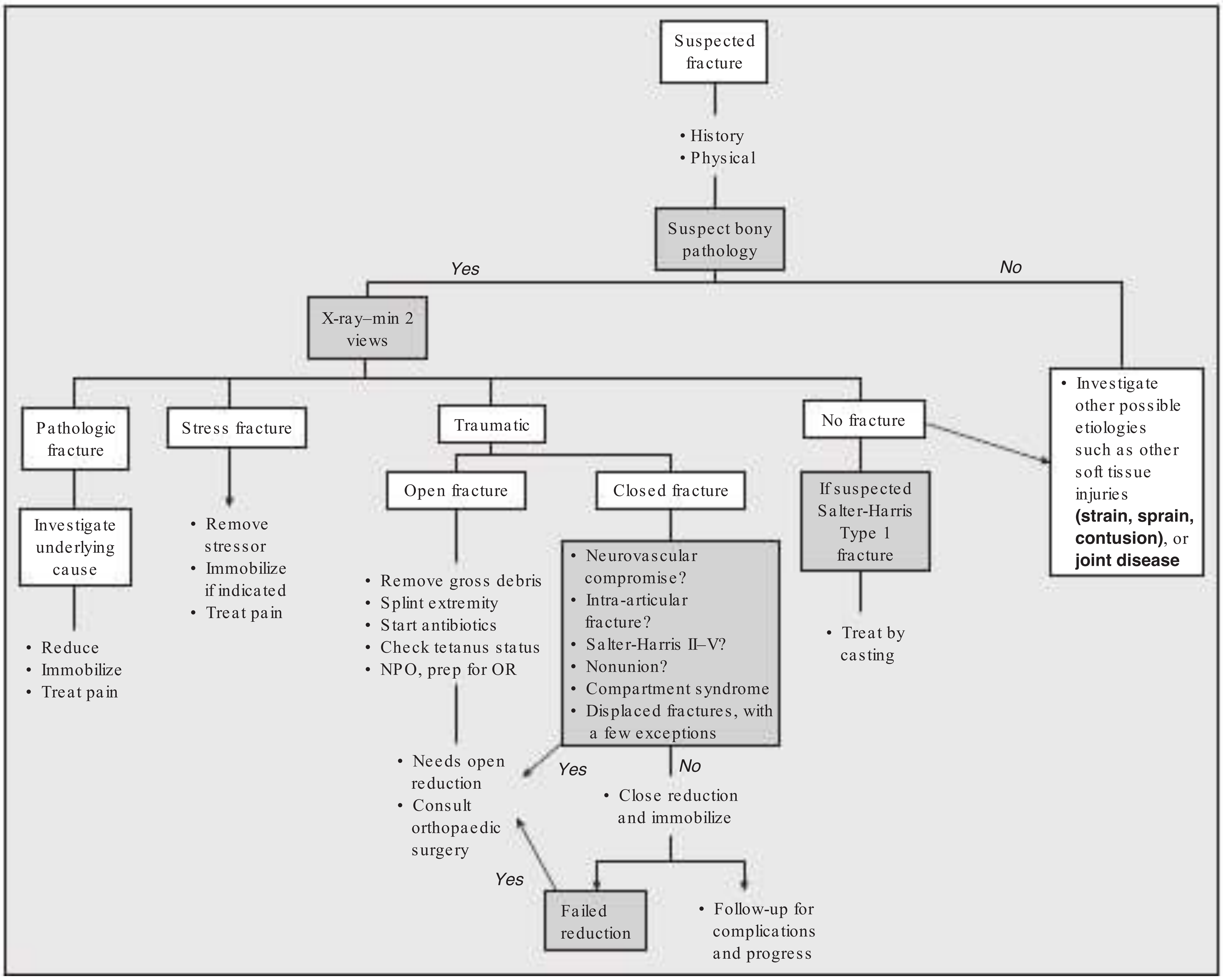


figure 16.4. Approach to a suspected fracture.

Physical Exam

- ATLS if high-risk mechanism. Rule out associated injuries, and ensure the patient is stable.
- *Inspection*: open versus closed injury, swelling, bruising, deformity, fracture blisters, cyanosis/pallor
- *Palpation*: tenderness, palpable deformity. Check for tense compartments, compartment tenderness, and pain on passive stretch if injury is high risk for compartment syndrome (see Clinical Box, Compartment Syndrome)

CLINICAL box

Compartment Syndrome

Initial symptoms—pain out of proportion to injury, increasing analgesia requirements

Initial physical signs—tense compartment(s) on palpation, loss of active function of the muscle(s) in the involved compartment(s), pain on passive stretch of muscles in compartment

Pulselessness and paresthesia are very rare late symptoms/signs and should never be relied upon to make the diagnosis.

Compartment syndrome is a clinical diagnosis! If the patient is obtunded, compartment pressures must be measured.

Must be recognized and treated promptly with fasciotomies in the OR to release the pressure.

note: The 5 Ps of vascular injury should never be confused with compartment syndrome. These are distinct entities. But, compartment syndrome can occur when a patient with a vascular injury has a prolonged warm ischemia time and revascularization is performed. This can lead to reperfusion edema, leading to compartment syndrome.

- *ROM:* may not be possible due to the injury
- *Neurovascular status*: assess sensation in the distribution of peripheral nerves, feel for pulses, and check capillary refill distal to the fracture
- Remember to examine the joint above and below!

Investigations

Laboratory Investigations

- For pathologic fractures: serum calcium, phosphate, alkaline phosphatase, PTH, TSH, T_3/T_4, SPEP, and UPEP as applicable to each patient. Check bone density with DEXA scan for osteoporotic fractures.

Imaging (see Clinical Box, Describing a Fracture)

- X-rays: first-line imaging in suspected fractures, with a minimum of two views needed to characterize the fracture. If a reduction is done, remember to order postreduction x-rays. In the case of suspected ankle fractures, use the Ottawa ankle rules to determine when imaging is needed (see Clinical Box, Ottawa Ankle Rules).
- CT: may be needed for more complex and intra-articular fractures
- MRI: may be able to visualize occult fractures and bone bruising and edema. Can visualize meniscal and ligamentous injuries associated with the injury.
- Bone scan: consider in case of pathologic fracture

Invasive Investigations

- Bone biopsy: may be indicated for pathologic fractures

Management (see Clinical Box, Complications after Fractures)

- Reduce fracture or dislocation (i.e., realign fracture fragments) and splint or cast (see Clinical Box, Complications of Casting), as appropriate. Obtain postreduction x-rays.

CLINICAL box

Complications after Fractures

Local	Systemic
Hemorrhage	DVT/PE
Damage to nerves	Fat embolism syndrome
Infection (soft tissue or osteomyelitis)	ARDS
Fracture blisters (caused by shear forces on the skin at the time of the injury); skin necrosis or massive degloving	
Compartment syndrome	
Malunion	
Nonunion	
Posttraumatic arthritis	
Osteonecrosis	
Heterotopic ossification	

- Antibiotic coverage and tetanus immunization (if not up to date) if open fracture. Ancef ± aminoglycoside ± anaerobic coverage depending on extent of soft tissue injury and contamination.
- Orthopaedic or plastic surgery consultation, depending on location of fracture. May need operative treatment. May need vascular surgery consultation if associated vascular injury. Note: not all fractures need specialist referral or splinting (e.g., rib fractures).
- Expedite referral for urgent care in case of life- or limb-threatening injuries
- Risk of malunion (healing in a nonanatomic position) or nonunion (failure of fracture healing)
- *Pathologic fractures:* metastatic workup if concerns for malignancy. May not be appropriate for immediate operative treatment before workup depending on underlying pathology.
- *Osteoporotic fracture*: will need follow-up regarding prevention and treatment of osteoporosis. Management may include vitamin D and calcium supplementation, a course of bisphosphonates, and falls prevention.

CLINICAL box

Describing a Fracture

Which bone?

Where in the bone?

What is the fracture pattern? (e.g., transverse, oblique, spiral, avulsion)

What is the relationship of the fragments? (angulation, translation, rotation, shortening)

Number of fragments (i.e., amount of comminution)

Intra-articular versus extra-articular

Open or closed

CLINICAL box

Ottawa Ankle Rules

Ankle x-rays indicated if:

- Bony tenderness along the posterior edge or tip of distal 6 cm of the lateral malleolus or
- Bony tenderness along the posterior edge or tip of distal 6 cm of the medial malleolus or
- Unable to bear weight immediately after injury and in emergency department

Foot x-rays indicated if:

- Bony tenderness at base of 5th metatarsal or
- Bony tenderness at navicular or
- Unable to bear weight immediately after injury and in emergency department

CLINICAL box

Complications of Casting

Pressure sores

Compartment syndrome

Soft tissue injury

Muscle atrophy

Swelling

Chafing/pruritus

- *Stress fractures*: activity modification and protective footwear/cast. May require operative treatment if nonunion, fracture propagation, or long-term disability develops.
- If child abuse is suspected, report to child protective services as per local regulations
- If predisposing factors (e.g., elderly patient with falls risks), counsel and educate regarding risk factors (e.g., falls prevention strategies)

HAND AND WRIST INJURIES

MCC Objective

Based on Objective #109-9 (Hand and/or Wrist Injuries) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Injuries to the hand and wrist can have significant consequences for short- and long-term patient functioning. Prompt diagnosis and appropriate management are crucial.

APPLIED SCIENTIFIC CONCEPTS

- Anatomy (Figure 16.5):
  - Bones: 8 carpals, 5 metacarpals, 3 phalanges in each finger (proximal, middle, and distal), 2 phalanges in thumb

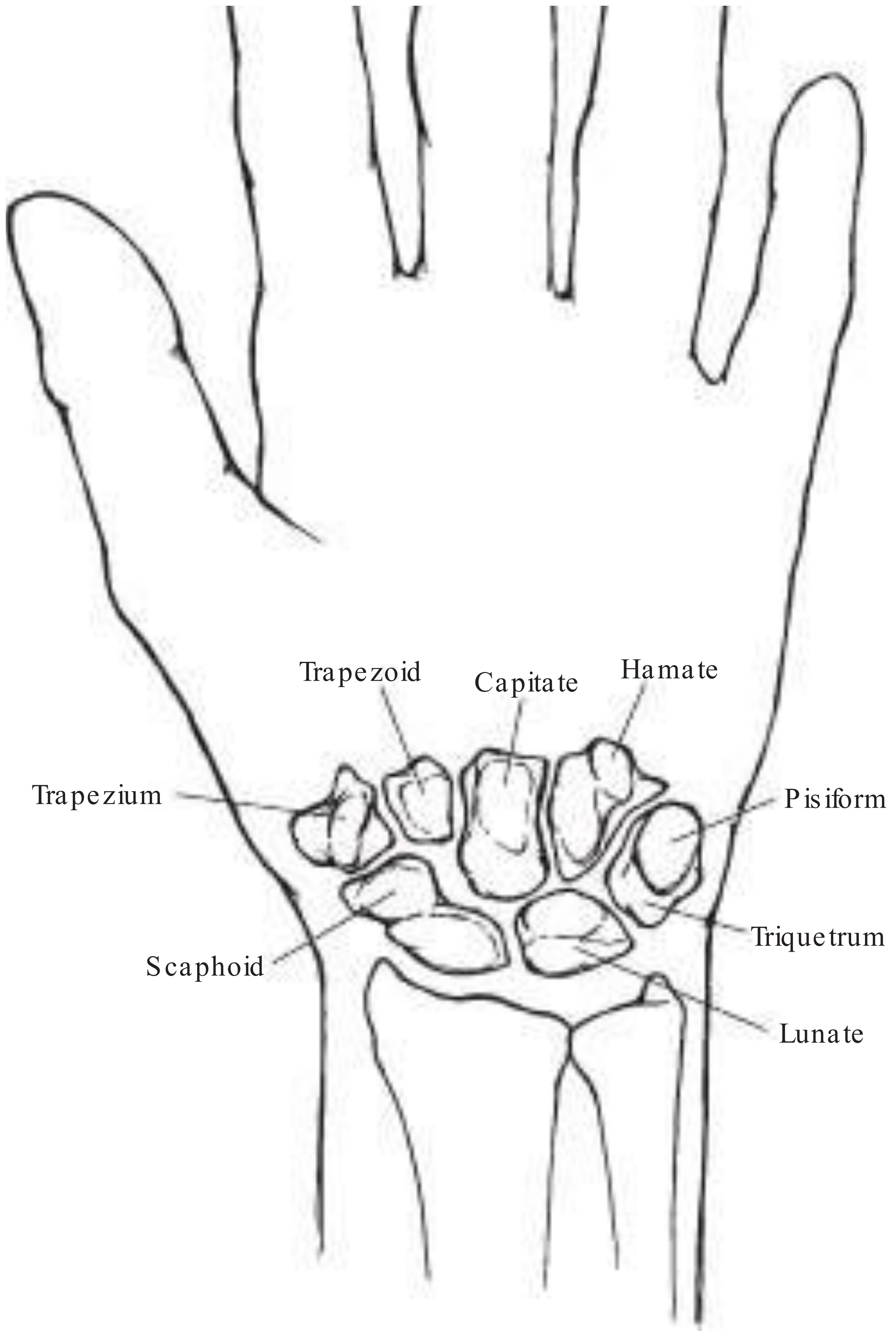


Figure 16.5. Hand and wrist anatomy. (From Oatis CA. Kinesiology: The Mechanics and Pathomechanics of Human Movement. Baltimore, MD: Lippincott Williams & Wilkins; 2004.)

- Joints: MCP, PIP, DIP. Thumb has only IP joint between phalanges and CMC joint.
- Tendons: 12 extensor and 12 flexor tendons
- Nerves: medial, radial, and ulnar nerves
- Vessels: blood supply via radial and ulnar arteries

CAUSAL CONDITIONS

Injuries to the hand and wrist can be classified according to the structures injured (Table 16.4).

TABLE 16.4 • Causal conditions for hand and wrist pain

Bones	Fractures
Joints	Dislocations Arthritis (RA, OA)
Tendons	de Quervain tenosynovitis Lacerations Tendonitis Trigger finger Infectious tenosynovitis
Nerves	Lacerations Carpal tunnel
Other	Dupuytren contracture

APPROACH

History

- *Symptoms*: pain, stiffness, weakness, sensory loss, duration of symptoms
- *Trauma*: history of trauma? Ask about mechanism, open injuries, possible contamination, timing of injury. If open injury, ensure you ask about tetanus vaccination status.
- *Pain*: location, onset, alleviating or aggravating factors, quality, radiation, severity
- *Risk factors for repetitive stress injuries*: vibration, overloading, repetitive activities
- Functional impact on patient
- Any previous investigation and results of investigations. Previous treatment/management and whether it helped with symptoms.
- *Medical history*: inflammatory conditions, previous injuries, or surgery to hand and wrist
- *Social history*: handedness, occupation, recreational activities, smoking, alcohol use
- *Family history*: inflammatory conditions

Physical Exam

- *Inspection*: open injuries including "fight bites," swelling, bruising, deformity, and muscle atrophy (more important for chronic conditions). Assess the resting position of the fingers (to assess for flexor and extensor tendon injuries) and the position of the fingers in flexion (fingers should point to base of scaphoid). Assess for scissoring (caused by rotational deformity).
- *Palpation*: test each joint and bone separately. Check for snuffbox (dorsal) and scaphoid tubercle (volar) tenderness for a suspected scaphoid fracture.
- *ROM*: active and passive. Test superficial and deep flexor tendons independently for each finger.
- *Neurovascular exam*: strength and sensation for medial, radial, and ulnar nerves (Table 16.5). Radial pulse, Allen test, capillary refill.
- *Special tests*: Phalen test and Tinel sign (carpal tunnel), Finkelstein test (de Quervain tenosynovitis), and assess for Kanavel cardinal signs (for purulent tenosynovitis)

Investigations

- X-ray: first-line imaging. Ask for scaphoid views if suspicious for scaphoid fracture.
- CT/MRI: may be needed for more information
- U/S: consider if infectious tenosynovitis

TABLE 16.5 • Motor and sensory testing for median, radial, and ulnar nerves

	Motor	Sensation
Radial	Thumb extension (EPL muscle)	1st dorsal webspace
Median	Thumb abduction (APB muscle)	Volar aspect of index finger
Ulnar	Finger abduction (interossei muscles)	Volar aspect of 5th digit

Management

- Initial management: reduce and splint fractures, suture open injuries. Use position of safety when splinting hand to minimize stiffness (Figure 16.6).

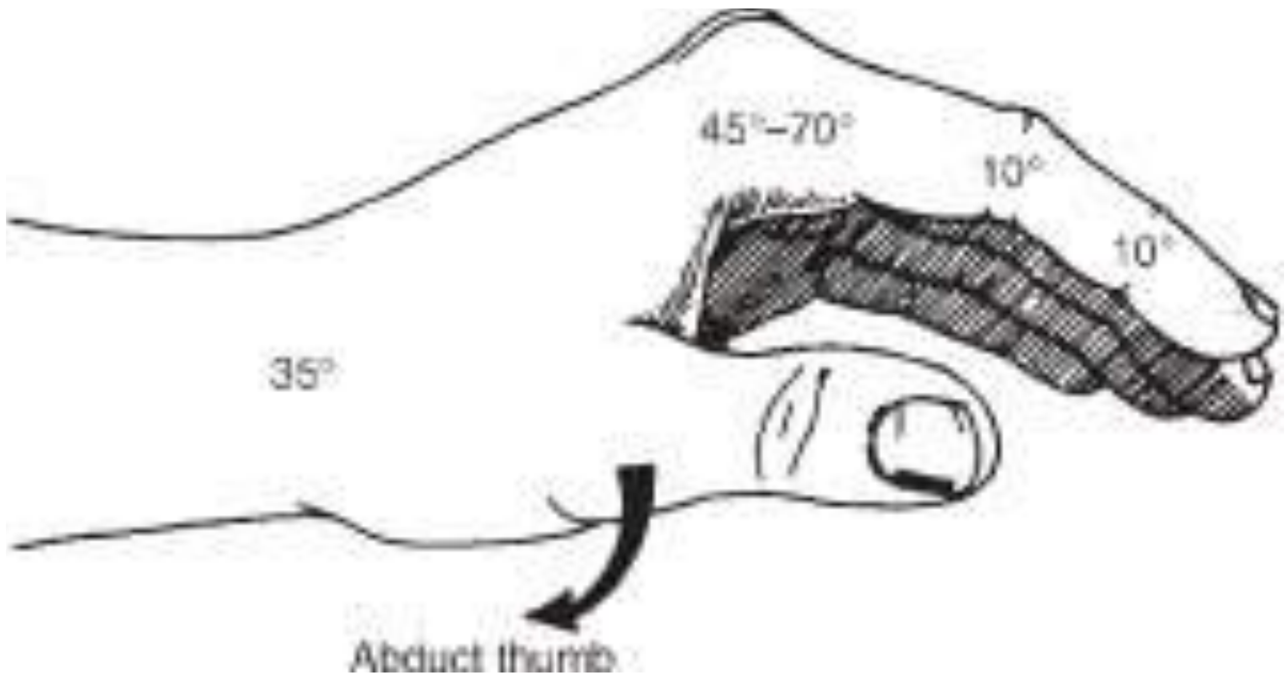


Figure 16.6. Position of safety. (From Seiler JG III. Essentials of Hand Surgery. Philadelphia, PA: Lippincott Williams & Wilkins; 2002, with permission.)

- Antibiotic coverage if open injuries, "fight bite" or animal bite, and infected tenosynovitis. Tetanus booster, if needed.
- Referral to plastic surgery, orthopaedic surgery, or rheumatology, as appropriate
- Long-term: wrist fractures can cause posttraumatic arthritis and stiffness.

Common injuries to the hand and wrist can be found in Table 16.6.

TABLE 16.6 • Some common injuries to the hand and wrist

Condition	Etiology	Signs and Symptoms	Treatment
Bones			
Fractures. Dislocations	• Trauma	• Deformity, bruising, swelling, tenderness ± scissoring • Decreased ROM	• Reduce and splint • Antibiotics and surgical debridement if open fracture
Tendons			
Laceration or rupture	• Trauma	• Loss of active ROM	• Will need surgical repair
de Quervain tenosynovitis	• Inflammation of 1st dorsal extensor compartment, usually from overuse, posttraumatic • Risk factors: female	• Finkelstein test positive • Radial-sided wrist pain	• Immobilization, NSAIDs, activity modification, steroid injections • May need surgical release of 1st dorsal extensor compartment
Trigger finger	• Irritation or inflammation of flexor tendon sheath • Due to repetitive use or direct pressure	• Sensation of "snapping," finger locking in flexion, loss of smooth ROM	• Immobilization, steroid injections • May need surgical release
Infectious tenosynovitis	• Most often associated with streptococcal or staphylococcal infections • Can be from skin wounds	• Usually on volar side of tendon sheath • Kanavel sign positive	• Antibiotics • Incision and drainage

(Continued)

TABLE 16.6 • Continued

Condition	Etiology	Signs and Symptoms	Treatment
Nerves			
Carpal tunnel syndrome	• Compression of median nerve in carpal tunnel • Risk factors: occupation, pregnancy, obesity, hypothyroidism, renal disease, diabetes, RA, female	• Pain and/or sensory loss in median nerve distribution, worse at night • Thenar atrophy • Weak thumb abduction • Decreased two-point discrimination • Positive Tinel, Phalen, carpal compression	• Splinting, activity modification, NSAIDs, steroid injections • May need carpal tunnel release
Soft Tissue			
Puncture wounds or bites	• Trauma • Beware of industrial pressure injection gun injuries. Refer promptly.		• Tetanus booster if not up to datew • Antibiotic coverage • Irrigate and clean wound but do not suture closed

SPINAL TRAUMA

MCC Objective

Based on Objective #109-13 (Spinal Trauma) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Spinal trauma causes damage to the cord, conus, or cauda equina via contusion, compression, stretch, or laceration.
- Patients are more likely to be young males.
- Mechanism of injury can range from low energy (e.g., fall from standing) to high energy (e.g., MVC or fall from height).
- Leads to symptoms ranging in severity from some temporary loss of neurologic function to permanent, total loss of motor and sensory functions below the level of injury. Can have debilitating effects on the patient's long-term functioning.
- Respiratory compromise is more likely with injuries higher in the spinal cord.
- A significant percentage of vertebral injuries occur at noncontiguous levels—ensure you assess for injuries along the entire spinal column.

APPLIED SCIENTIFIC CONCEPTS

- The spinal column can be thought of as 3 columns: anterior (anterior longitudinal ligament, anterior vertebral body, anterior annulus), middle (posterior longitudinal ligament, posterior vertebral body, posterior annulus), and posterior (pedicles, facets, lamina, posterior ligamentous complex) columns.
- Spinal cord ends and cauda equina begins at about L1/L2 in an adult.
- Spinal stability implies that normal physiologic loads do not cause neurologic injury, pain, or deformity.
- *Primary injury* to the cord is due to the effect of mechanical forces. *Secondary injury* refers to additional damage to the cord from the response initiated by the primary injury.
- Injuries of the vertebral column are more likely to occur at the transitional areas (i.e., between the occiput and cervical spine, at the cervicothoracic junction and at the thoracolumbar junction).
- *Spinal shock*: temporary loss of spinal cord function and reflexes below level of injury. Symptoms include absent reflexes and flaccid paralysis. Usually resolves within 24 to 48 h. Return of reflexes below level of injury (e.g., bulbocavernosus reflex) indicates end of spinal shock.

- *Neurogenic shock*: loss of sympathetic tone leading to hypotension, bradycardia. Needs to be urgently recognized and treated, as it can be life threatening.

CAUSAL CONDITIONS

Forces causing spinal trauma

- Contusion: due to compression of cord during primary injury, with both reversible and irreversible effects
- Compression: caused by decreased size of spinal canal due to, for example, translation of spinal column, hematoma formation, disc displacement or rupture
- Stretch: longitudinal traction causing disruption of blood supply and axons
- Laceration: can be due to penetrating foreign bodies (e.g., gunshot or stab injuries) or bone fragments

Types of injury include:

- Fracture
- Dislocation
- Penetrating injury (e.g., stab or gunshot)
- Traumatic disc rupture

APPROACH

History

- Mechanism of injury, any associated head trauma or other injuries, any neck or back pain
- *Alertness*: initial GCS, any loss of consciousness, and any changes in level of consciousness
- Any prehospital treatment received by the patient (e.g., intubation, rigid C-spine collar)
- *Neurologic symptoms*: weakness and sensory changes, even if transient changes after injury. Remember to ask about symptoms of cauda equina (see Red Flag Box, Signs and Symptoms of Cauda Equina).
- Medical history, including any previous neck or spine trauma or surgery, any history of osteoporosis or conditions making more prone to spinal injuries (e.g., ankylosing spondylitis, diffuse idiopathic skeletal hyperostosis, any conditions causing ligamentous laxity)
- Allergies, medications, social history. When the patient last ate or drank (if OR may be needed).

Physical Exam

- Vital signs
- ATLS assessment, including airway, breathing, circulation, disability, exposure (ABCDE), and resuscitation. Rule out other injuries. Check for "seat belt sign," suggesting possible flexion-distraction injury or associated abdominal injury.
- Remember to logroll the patient to check for penetrating injuries involving the spine, bruising, tenderness, and step deformities. Check anal sphincter tone.
- Protect the spine at all times while assessing and managing the patient's injuries—implement spinal immobilization while taking history and doing exam. Use a spine board and rigid C-spine collar, as appropriate. When cervical immobilization is removed, use manual inline traction to maintain stability.
- *Neurologic exam*: check cranial nerves, upper and lower extremity strength and sensation for each dermatome and myotome (see Clinical Box, Grading Muscle Strength), reflexes, perianal sensation, and anal tone with a DRE. Refer to the standard neurologic exam recommended by the ASIA (Figure 16.7).

Investigations

Laboratory Investigations

- Usual trauma blood work, including CBC, electrolytes, renal function, blood alcohol levels, drug screen, and coagulation

Imaging

- X-rays: C-spine (AP, lateral, odontoid views), thoracolumbar spine (AP, lateral). **Imaging may be normal even if spinal cord is injured!** Consult the Canadian C-spine rules to determine when x-rays are needed in possible C-spine injuries (see Figure 16.1).
- CT: consider if appropriate—better for bony detail

CLINICAL box

Grading of Muscle Strength

0 = total paralysis
1 = palpable or visible contraction
2 = active movement, full ROM with gravity eliminated
3 = active movement, full ROM against gravity
4 = active movement, full ROM against gravity, and moderate resistance in a muscle-specific position.
5 = (normal) active movement, full ROM against gravity, and full resistance in a muscle-specific position expected from an otherwise unimpaired person
5^* = (normal) active movement, full ROM against gravity, and sufficient resistance to be considered normal if identified inhibiting factors (i.e., pain, disuse) were not present
NT= not testable (i.e., due to immobilization, severe pain such that the patient cannot be graded, amputation of limb, or contracture of > 50% of the ROM)

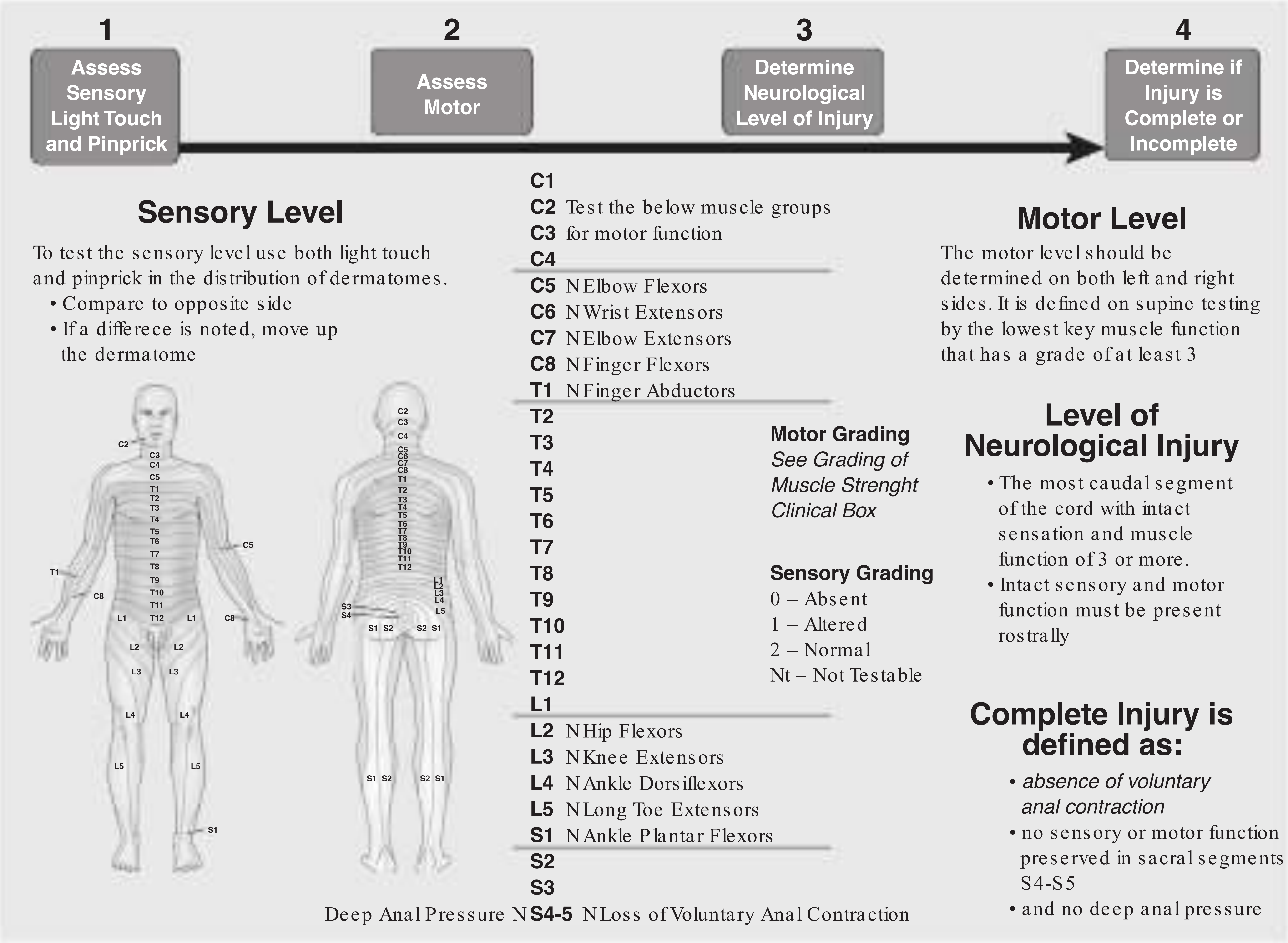

1
Assess Sensory Light Touch and Pinprick
2
Assess Motor
3
Determine Neurological Level of Injury
4
Determine if Injury is Complete or Incomplete
Sensory Level
To test the sensory level use both light touch and pinprick in the distribution of dermatomes.
• Compare to opposite side
• If a differece is noted, move up the dermatome
C2
C3
C4
C5
T1
T2
T3
T4
T5
T6
T7
T8
T9
T10
T11
T12
C8
L1
L2
L3
L4
L5
S1
S2
S3
S4
C1
C2 Test the below muscle groups
C3 for motor function
C4
C5 → Elbow Flexors
C6 → Wrist Extensors
C7 → Elbow Extensors
C8 → Finger Flexors
T1 → Finger Abductors
T2
T3
T4
T5
T6
T7
T8
T9
T10
T11
T12
L1
L2 → Hip Flexors
L3 → Knee Extensors
L4 → Ankle Dorsiflexors
L5 → Long Toe Extensors
S1 → Ankle Plantar Flexors
S2
S3
Deep Anal Pressure → S4-5 → Loss of Voluntary Anal Contraction
Motor Grading
See Grading of Muscle Strenght Clinical Box
Sensory Grading
0 – Absent
1 – Altered
2 – Normal
Nt – Not Testable
Motor Level
The motor level should be determined on both left and right sides. It is defined on supine testing by the lowest key muscle function that has a grade of at least 3
Level of Neurological Injury
• The most caudal segment of the cord with intact sensation and muscle function of 3 or more.
• Intact sensory and motor function must be present rostrally
Complete Injury is defined as:
• absence of voluntary anal contraction
• no sensory or motor function preserved in sacral segments S4-S5
• and no deep anal pressure

figure 16.7. Spinal injury neurologic exam.

- MRI: consider if appropriate—better for information on soft tissue, ligaments, discs, and spinal cord
- Any imaging may have to be deferred if the patient is unstable.

CLINICAL box

Criteria for Clearing the Spine

Full and nontender ROM

No posterior midline tenderness

No focal neurologic deficits

Not intoxicated or otherwise obtunded

No distracting injuries

Classification

- Neurologic level: lowest spinal level with normal neurologic function bilaterally
- Complete versus incomplete SCI: a complete SCI has no voluntary motor or sensory function below the level of the injury. An incomplete injury has some function below the level of injury after the return of the bulbocavernosus reflex. There is higher risk of ventilatory compromise with a complete SCI.
- Tetraplegia/quadriplegia: loss of sensory/motor function in the cervical levels
- Paraplegia: loss of sensory/motor function in the thoracolumbar levels

Management

- Ongoing assessment of the patient's neurologic status is needed as the status immediately after injury may not reflect the true extent of the injury. Clearing the spine suggests that the spine has been evaluated carefully and that no injury has been found (see Clinical Box, Criteria for Clearing the Spine).
- Appropriate immobilization (e.g., C-spine collar, spine board), depending on the level of injury. Try to discontinue use of spine board as soon as possible as it can lead to pressure sores.
- Maintain MAP to keep spinal cord perfusion
- Use of steroids for SCI is controversial.
- Consult ICU and spine surgery as needed. Surgery may be needed to decompress the cord and stabilize the spine.

- After the immediate management of the injury, patients with spinal cord injuries will likely need the involvement of physiatry, physiotherapy, and occupational therapy for recovery.
- Depending on the level and severity of injury, patients may require interventions such as mechanical ventilation, bladder catheterization, or feeding tubes.
- Longer-term complications include UTIs, aspiration, pneumonia, atelectasis, gastritis, and pressure sores.

CLINICAL box

Referred Pain

Knee pain can be due to referred pain from problems in the hip.

CLINICAL box

Growing Pains

Typically poorly localized pain in the lower limbs (especially the lower legs) at night. Most often in children 2 to 12 y.o.

LIMP IN CHILDREN

MCC Objective

Based on Objective #20 (Limp in Children) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Epidemiology: about 2/1,000, M > F, hip > knee > leg
- Ensure that child abuse is ruled out

APPLIED SCIENTIFIC CONCEPTS

- Limp: labored, jerky, or strenuous way of walking
- Can be caused by weakness, pain, or deformity
- Usually caused by benign conditions, but may be life or limb threatening
- Benign conditions less likely to be unilateral

CAUSAL CONDITIONS (see Clinical Boxes, Referred Pain and Growing Pains)

Can be classified according to anatomic site of pathology or pathologic process. Some common causes include:

- Pathologic processes:
  - Trauma: fractures, dislocations, contusions, sprains, bursitis, child abuse, stress fractures, foreign body in foot
  - Infectious: septic arthritis, osteomyelitis, cellulitis, SI joint infection, psoas abscess
  - Inflammatory: juvenile rheumatoid arthritis, transient synovitis, reactive arthritis
  - Hematologic: leukemia, sickle cell, hemophilia
  - Neoplastic: Ewing sarcoma, osteosarcoma, osteochondroma, other malignancies
  - Metabolic: rickets
  - Neuromuscular: muscular dystrophy
  - Other: growing pains, footwear, leg length discrepancy
- Anatomic causes:
  - CNS: meningitis, cerebral palsy, discitis, epidural abscess
  - Hip: Legg-Calve-Perthes, SCFE, DDH, transient synovitis
  - Knee: Osgood-Schlatter, patellar dislocation, meniscal injury, patellofemoral syndrome

APPROACH

History

- *Limp*: duration, alleviating and aggravating factors, previous episodes
- *Trauma*: history of trauma? Recent increases in activity (may suggest stress fractures)?
- *Pain*: is there pain? Chronicity relating to limp. Location, onset, alleviating or aggravating factors, quality, radiation, severity. Night pain and rest pain are more concerning.
- *Constitutional symptoms*: fever, night sweats, unexplained weight loss
- *Infectious symptoms*: fever, swelling, erythema, recent infections (postinfectious arthritis typically after viral or Streptococcal infections), warm joints, back pain
- *Inflammatory symptoms*: morning stiffness, warm joints
- Functional impact on patient

i i a p i i a i mp m i a i a a m

ip

f i

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CLINICAL box

Types of Limp

- **antalgic gait**: Due to pain in the weight-bearing leg causing a short stance phase in gait. Most common cause of limp.
- **trendelenburg gait**: Due to weak abductor muscles such that when standing on the affected side, the pelvis drops on the opposite side.

- *Medical history*: corticosteroid use (increased risk of avascular necrosis), coagulopathy (can cause hemarthrosis), hypothyroidism (associated with SCFE)
- *Family history*: malignancy, sickle cell, inflammatory disorders

Physical Exam

- *Vitals*: suggestive of infection?
- *Inspection*: gait (see Clinical Box, Types of Limp), erythema, swelling, asymmetry/deformity in limbs or spine, leg length discrepancy (measure directly and check Galeazzi sign)
- *Palpation*: effusions, tenderness, masses
- *ROM*: active and passive
- *Neurovascular exam*: strength, sensation, pulses
- *Special tests*: Trendelenburg sign for abductor weakness, Ortolani and Barlow tests for DDH, FABER test for SI joint pathology, Psoas sign for abscess
- Remember to examine the joint above and below, and to check the spine

Investigations

Laboratory Investigations

- CBC, CRP/ESR
- Rheumatologic workup if suspicious for inflammatory arthritis
- Blood cultures if infection
- INR/PTT if concerned about coagulopathy
- Can also test for acute rheumatic fever, Lyme disease, gonococcal or reactive arthritis

Imaging

- X-ray: first-line imaging. May be normal in stress fractures, Salter-Harris I fractures, osteomyelitis, transient synovitis of the hip, septic arthritis, and early Legg-Calve-Perthes disease.
- U/S: can detect effusions. Used to look for DDH in infants < 4 to 6 mo.
- CT/MRI: spine, malignancy, osteomyelitis
- Bone scan: can detect occult fractures, stress fractures, malignant lesions, osteomyelitis

Invasive Investigations

- Joint aspiration
- Bone culture: for osteomyelitis
- Biopsy: for malignancy

Management (Table 16.7)

SUGGESTED READINGS

PRAISE Investigators. Prevalence of abuse and intimate partner violence surgical evaluation (PRAISE) in orthopaedic fracture clinics: a multinational prevalence study. *Lancet*. 2013;382:866–876.

CHAPTER

17

Otolaryngology

André Isaac • Raiyan Chowdhury

Table of Contents

Ear Pain
Dizziness / Vertigo
Epistaxis
Tinnitus
Hearing Loss
Sore Throat / Rhinorrhea
Smell and Taste Dysfunction
Mouth Problems
Neck Mass

EAR PAIN

MCC OBJECTIVE

Based on Objective #28 (Ear Pain) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Otalgia: nonspecific ear pain
  - Primary otalgia: pain originates within the ear.
  - Referred otalgia: pain originates from an organ that shares sensory innervation with the ear.
- Owing to the myriad of organs that share sensory innervation with the ear, the differential diagnosis is vast.

CLINICAL BOX

Most Common Causes of Otalgia

Primary: otitis media and externa

Secondary: dental pathology and pharyngeal infections

APPLIED SCIENTIFIC CONCEPT

Four nerves supply sensory innervation to the external ear: the great auricular nerve (from the cervical plexus), the lesser occipital nerve (from the cervical plexus), the auricular branch of the vagus nerve, and the auriculotemporal nerve (from the mandibular branch of the trigeminal nerve). The middle ear is supplied by branches of cranial nerves V, IX, and X. Because these nerves also supply sensory innervation to much of the aerodigestive tract, pathology anywhere along the upper aerodigestive tract can result in otalgia. The most worrisome possibility is a head and neck cancer that manifests as ear pain.

The Eustachian tube drains the middle ear into the nasopharynx. Eustachian tube pathology is important in the pathogenesis of otitis media and other middle ear diseases.

CAUSAL CONDITIONS (Figure 17.1 and Table 17.1)

APPROACH

History

- The presence of accompanying otologic symptoms, such as hearing loss, tinnitus, vertigo, and aural discharge, suggests a local cause.
- The coexistence of a dental infection, a pharyngeal mass, or pharyngeal pain suggests a referred cause.
- Acute otitis media and otitis media with effusion are the most common causes of middle ear pain, especially in children under the age of 7.
  - AOM is characterized by rapid onset of symptoms: otalgia, decreased hearing, and fever.
  - OME is often asymptomatic but can manifest as otalgia and/or hearing loss.

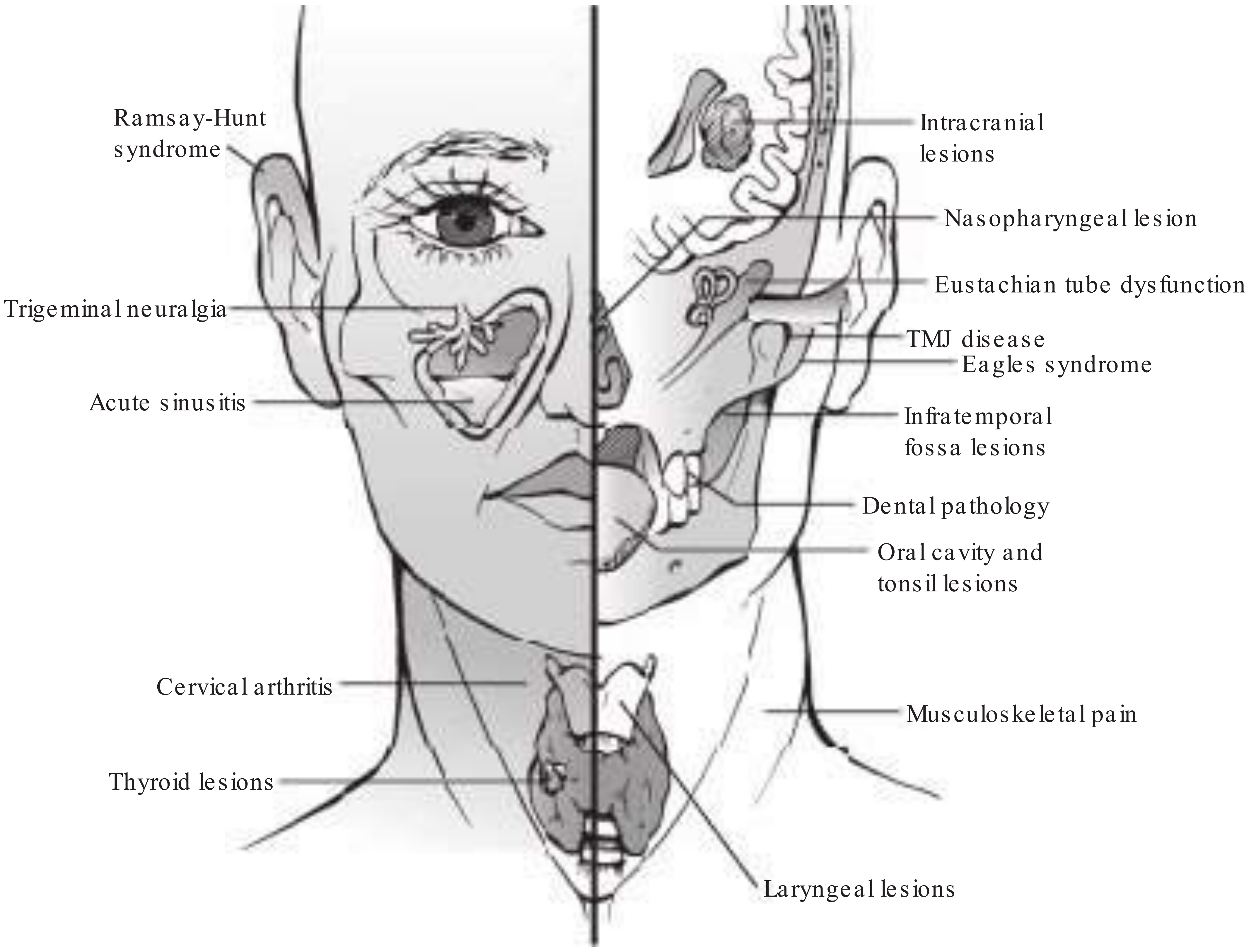


Figure 17.1. Causal conditions of ear pain.

TABLE 17.1 • Causal conditions of ear pain

External Ear	Middle and Inner Ear	Referred Pain
• Infections ◦ Otitis externa ◦ Herpes simplex and zoster ◦ Auricular cellulitis ◦ Perichondritis ◦ External canal abscess • Trauma ◦ Lacerations ◦ Frostbite ◦ Burns ◦ Hematoma • Tympanic membrane ◦ Bullous myringitis • Other ◦ Foreign body ◦ Cerumen impaction ◦ Neoplasm	• Infection/inflammation ◦ AOM ◦ Otitis media with effusion ◦ Mastoiditis ◦ Myringitis • Neoplasm • Other ◦ GPA (formerly knownas Wegner’s Granulomatosis	• Infection/inflammation ◦ Odontogenic infections ◦ Sinusitis ◦ Peritonsillar abscess ◦ Pharyngitis ◦ Parotitis ◦ Thyroiditis • Trauma • Neoplasm • Other ◦ Neuralgia ◦ Cervical spine disease ◦ TMJ dysfunction ◦ Wisdom teeth ◦ Migraine

- Otitis externa is the most common cause of external ear pain, caused by a bacterial infection in the outer ear
  - Ask about risk factors, including poor hygiene, a history of foreign body insertion or Q-tip use in the ear, and swimming (especially in dirty water)
- In the absence of other otologic symptoms, ask about head and neck cancer risk factors (smoking, alcohol, radiation)

Physical Exam

- An edematous external auditory canal, **with increased pain when pushing on the tragus or pulling on the pinna**, suggests otitis externa
- An erythematous and bulging tympanic membrane suggests an AOM
- Erythema **and fluctuance** over the mastoid region suggest mastoiditis
- Inspect the oral cavity and oropharynx for signs of infection, dental pathology, and neoplasm
- Inspect nasal cavity for purulent discharge, suggesting acute sinusitis
- Remember that mastoiditis is **clinical diagnosis**, not a radiologic one (see Red Flag Box, Mastoiditis)

Investigations

- Aimed at suspected underlying cause

Diagnosis

- Otitis media: see ASC Box
- Otitis externa: commonly a pseudomonal infection, diagnosis is based on history and physical exam (see above)
  - Make sure to rule out malignant otitis externa: rapidly destructive osteomyelitis of the temporal bone in an immunocompromised host

Management

- Acute otitis media:
  - If no contraindications, can treat with close observation and symptomatic management
    - **Contraindications to observational management:**
      - Age < 6 mo
      - Immune deficiency or disorder
      - Severe illness or treatment failure
      - Inability to ensure follow-up and rescue Abx
  - If contraindications or severe case, first-line treatment is high-dose amoxicillin
  - Second-line treatment includes amoxicillin-clavulanate, second-generation cephalosporins
  - Patients with persistent or recurrent infections may be candidates for myringotomy and tube insertion
  - Prevention: breast feeding, sick contacts, passive smoking, crowded living conditions, and day care
- Otitis externa:
  - Antipseudomonal ear drops (e.g., Ciprodex)
  - May require oral antipseudomonal abx if severe
  - Often requires manual debridement or ear wick insertion if canal is edematous or obstructed

DIZZINESS / VERTIGO

MCC OBJECTIVE

Based on Objective #24 (Dizziness, Vertigo) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Dizziness is a common complaint to describe a nonspecific symptom.
- It is important to differentiate *vertigo* from other forms of "dizziness."
  - Vertigo is an illusion of movement, most commonly spinning or turning of oneself or one's environment.

Head and Neck Cancer

History of heavy tobacco and alcohol use without another evident cause of otalgia, refer to an otolaryngologist to evaluate upper aerodigestive tract to rule out head and neck cancer. Carefully examine all oropharyngeal mucosal surfaces for leukoplakia, ulcers, and asymmetric masses.

Mastoiditis

Mastoiditis is a potentially life-threatening complication of AOM. It manifests as erythema and swelling over the mastoid region, which is located immediately posterior to the external ear. If suspected, administer Abx intravenously and urgently refer to an otolaryngologist for surgical debridement.

ASC box

Otitis Media

- Otitis media is the most common pediatric cause of otalgia.
- Arises from Eustachian tube obstruction secondary to edema from URTI, allergies, or an inadequate opening
- Leads to negative middle ear pressure, causing influx of pathogens from nasopharynx
- Most common: S. pneumoniae, H. *flu*, M. catarrhalis, and viruses

- Vertigo can be caused by diseases of the vestibular system (peripheral vertigo) or CNS (central vertigo).

APPLIED SCIENTIFIC CONCEPT

The sensation of movement is controlled by an interaction between the vestibular system and the CNS.

The vestibular system includes the utricle, saccule, and three semicircular canals (lateral, posterior, and superior). The utricle and saccule detect linear acceleration (the utricle detects horizontal acceleration, whereas the saccule detects vertical acceleration), while the semicircular canals detect angular acceleration. The utricle and saccule are the "otolith organs"—they contain calcium carbonate crystals (otoliths); the displacement of which causes movement of sensory hair cells that transduce the information into a neural signal of movement. Diseases of the utricle, saccule, and semicircular canals can result in an inappropriate sensation of linear or angular acceleration: vertigo.

The CNS has a more complicated role in motion sensing and control of balance, with contributions from the cerebellum, cerebral cortex, and brainstem.

CAUSAL CONDITIONS

Dizziness

- True vertigo (50%)
  - Peripheral (40%)
    - BPPV
    - Vestibular neuronitis
    - Labyrinthitis
    - Ménière disease
    - Ototoxicity
  - Central (10%)
    - CPA tumor
    - CVA
    - MS
    - Drugs (anticonvulsants, alcohol)
- Nonvertiginous dizziness
  - Disequilibrium (15%)
    - Peripheral neuropathy
    - Visual impairment
  - Presyncope (10%)
  - Psychiatric (15%)

APPROACH (Figure 17.2)

History

- The history in the vertiginous patient is the most critical piece of the evaluation in establishing the diagnosis (Table 17.2).
- Define whether the patient is experiencing vertigo, disequilibrium, or presyncope:
  - True vertigo is a sensation of spinning of the self or environment.
  - Presyncope refers to light-headedness associated with cerebral hypoperfusion, classically presenting with blurred vision, nausea, tunnel vision, and diaphoresis.
  - Dizziness without a subjective feeling of rotation is not vertigo and should be approached differently.
- Peripheral vertigo is episodic and generally does not continue for a matter of weeks due to central compensation.
- It is important to ask about provoking factors, particularly head positions.
  - Vertigo that is brought on by turning over in bed is a classic symptom of BPPV.
- It is also important to ask about a history of trauma, or upper respiratory tract infection.
- Peripheral causes of vertigo are often associated with other otologic symptoms such as hearing loss and tinnitus.
  - It is important to ask whether the tinnitus and hearing loss are episodic and associated with the vertigo.
- Central causes of vertigo are often associated with neurologic symptoms such as diplopia, vision loss, unilateral weakness, dysarthria, and ataxia.

- The duration of the vertigo is critical for the differential diagnosis (seconds vs. minutes vs. hours vs. days).
- Vertigo lasting less than a minute, initiated consistently by a particular change in head position and not associated with other otologic findings is most likely BPPV.
- Vertigo lasting minutes to hours that is associated with fluctuating hearing loss, tinnitus, and aural pressure suggests Ménière disease.
- Tumarkin crisis—sudden falls occurring without warning and without LOC (associated with Ménière disease).

Physical Exam

- See Table 17.2

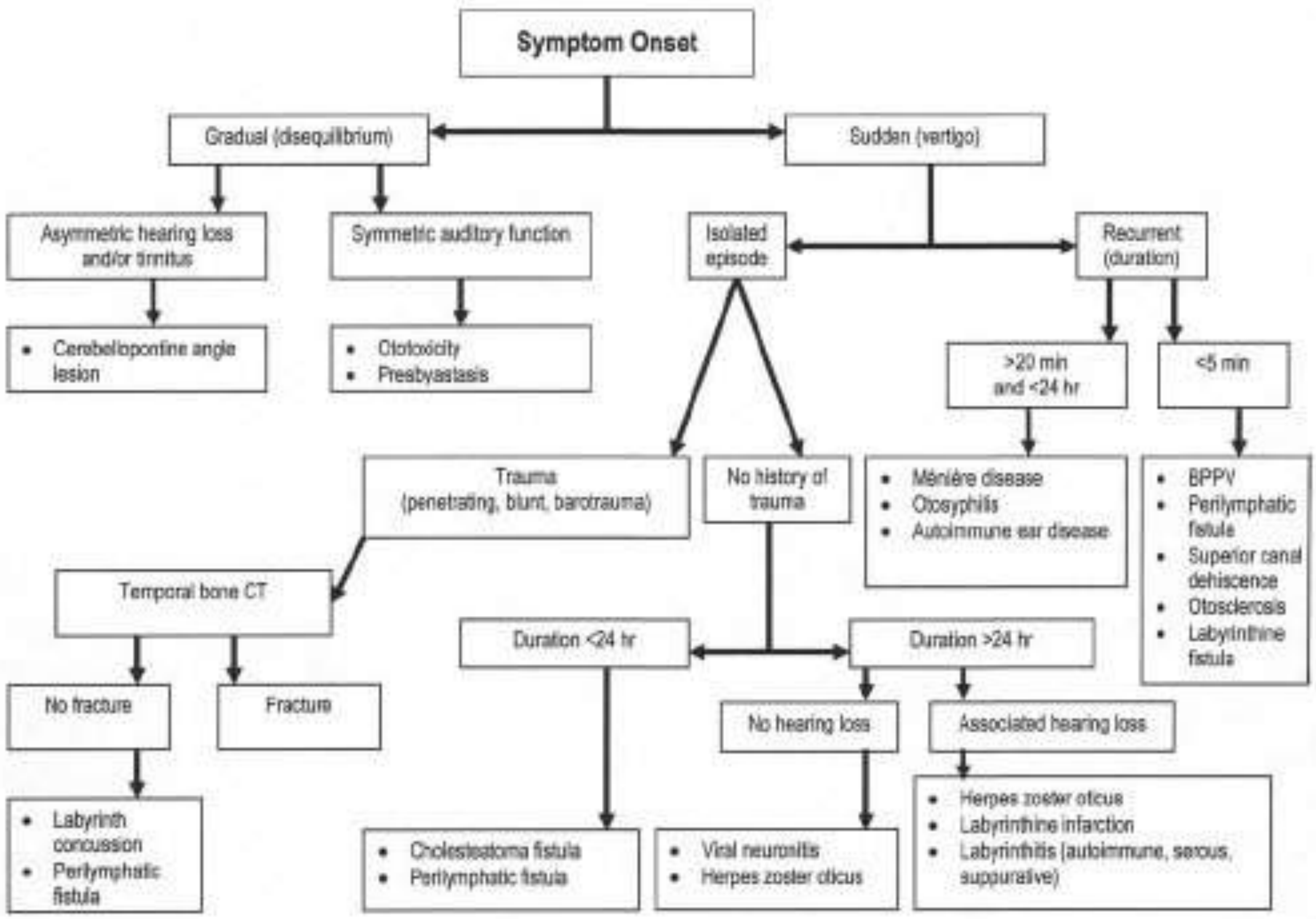


Figure 17.2. Approach to vertigo. (From Bailey BJ, Johnson JT, Newlands SD. Head & Neck Surgery—Otolaryngology. 4th ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2006.)

TABLE 17.2 • Peripheral versus central vertigo

	Peripheral	Central
Nystagmus	Horizontal, never vertical	Vertical or horizontal
	Never reverses direction	Can reverse direction with change of direction of gaze
Neurologic signs and symptoms	Absent	Common
Otologic signs and symptoms	Common	Absent
Time course	Abrupt onset/offset, never continuous due to central compensation	Tends to be continuous

CLINICAL box

Dix-Hallpike Maneuver

1. With the patient's head rotated 45 degrees to one side, quickly lay the patient down with the head hanging over the edge of the table. Hold the position for at least 30 sec, and note the presence of vertigo and nystagmus.
2. Bring the patient back up to upright position, and repeat the maneuver on the opposite side

- Inspect the tympanic membrane, paying particular attention to infection and/or tympanic membrane perforation
- Assess the hearing using the Weber and Rinne tuning fork tests (see Hearing Loss)
- Inspect the eyes for nystagmus during an acute attack
  - Peripheral vertigo is associated with horizontal nystagmus (never vertical), and never reverses direction
  - Central vertigo is associated with horizontal or central nystagmus, and can reverse direction with change of gaze
- Perform a neurologic exam, including cranial nerves and peripheral sensation
- If BPPV is suspected based on history, perform a Dix-Hallpike maneuver (see Clinical Box, Dix-Hallpike Maneuver)

Investigations

Laboratory Testing

- Routine laboratory investigations for vertigo are not recommended.
- Blood work can help to rule out other common causes of dizziness if they are expected, such as anemia, electrolyte abnormalities, some drug toxicities, or hypothyroidism.

Imaging

- If there is a history of trauma or if specific temporal bone pathology is suspected, a CT scan of the temporal bones can be helpful. This should be ordered in consultation with an otolaryngologist.
- If a central cause of vertigo is suspected, a CT head may be useful to rule out CVA or a space-occupying lesion.

Special Tests

- ENG: this encompasses a battery of electrophysiologic investigations and is usually ordered by an otolaryngologist. This includes caloric testing, where the ear canals are irrigated with cold and hot water. Nystagmus caused by cold water is toward the opposite ear, whereas hot water causes nystagmus toward the same ear (remember COWS: Cold Opposite, Warm Same).

diagnosis (Table 17.3)

TABLE 17.3 • Diagnosis of common causes of vertigo

Condition	History	Physical Exam	Investigations
BPPV	Vertigo lasting seconds, provoked by certain head positions, no hearing loss	Dix-Hallpike	None
Ménière disease	Vertigo lasting minutes to hours, Tumarkin crisis, fluctuating hearing loss, aural fullness	Tuning fork testing	None
Vestibular neuronitis	Vertigo lasting hours to days, viral prodrome, no hearing loss	Look for signs of viral infection	None
Labyrinthitis	Vertigo lasting days to weeks, viral or bacterial prodrome, unilateral hearing loss	Look for signs of viral or bacterial infection (esp. AOM, meningitis, etc.)	CT head if intracranial infection suspected, blood work if indicated
CNS disease	Diplopia, vision changes, focal neurologic signs	Full neurologic exam	CT if indicated

Management

- Most causes of vertigo are benign.
- Therapy should be aimed at the underlying cause.
- Unless red flags exist (e.g., signs of a central cause), reassure the patient and offer symptomatic relief
- Medications can be used to suppress vertigo during acute attacks:
  - Betahistine (useful in BPPV, may be used in Ménière's)
  - Antihistamines (meclizine, dimenhydrinate)
  - Anticholinergics (scopolamine)
  - Benzodiazepines (can help with anxiety as well)

- Ménière disease: salt restriction and thiazide diuretics can improve symptoms and prevent further attacks. Intratympanic steroids can sometimes be used (requires referral to an otolaryngologist).
  - Referral should be made to an otolaryngologist, as this disease can "burn out," causing permanent hearing loss.
- BPPV: the Epley maneuver can be therapeutic (vestibular physiotherapy technique to reposition otoliths).

EPISTAXIS

MCC OBJECTIVE

Based on Objective #122 (Epistaxis) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Epistaxis refers to bleeding that originates in the nasal cavity.
- The vast majority of cases are benign and self-limited, but epistaxis can be severe and life threatening.
- Primary epistaxis = due to local factors affecting the nasal mucosa/vascular tissue
- Secondary epistaxis = coagulopathic or "medical epistaxis"
- Posterior epistaxis = bleeding that fails routine anterior packing or direct therapy to the anterior septum

APPLIED SCIENTIFIC CONCEPTS

- Kiesselbach plexus: supplies "Little's area," in the anterior septum, containing the septal branch of the superior labial artery, the greater palatine artery, and anterior ethmoid artery.
- Woodruff plexus: supplies the posterior nasal septum, containing the sphenopalatine artery and posterior ethmoidal artery. Tends to be more severe, more difficult to control.

CLINICAL box

Anterior versus Posterior Epistaxis

The vast majority of epistaxis, even severe epistaxis, is anterior and can be controlled by direct pressure to the anterior septum. Posterior epistaxis quickly becomes life threatening, requiring embolization or surgery. Early specialist referral is recommended.

CAUSAL CONDITIONS

Primary Epistaxis

- Idiopathic (most common)
- Local irritants
  - Dry hair
  - Cold
- Trauma
  - Nose picking
  - Violence, accidents, etc.
- Anatomic deformities
  - For example, septal deviation, septal spur
- Allergy

Secondary Epistaxis

- Medications
  - Anticoagulants
- Coagulopathy
  - For example, hemophilia, thrombocytopenia

APPROACH

- ABCs
  - Ensure patient has a patent airway and is able to protect it
  - Ensure hemodynamic stability
  - If hemodynamically unstable, call for help, IV, O_2, monitors, start immediate intervention to secure an airway (if indicated), start fluid resuscitation, and have blood products on hand. **Otolaryngology referral ASAP**.
  - If stable, apply anterior pressure to the soft part of the nose and proceed with history

history

- Onset, duration, amount of bleeding (most patients will overestimate the amount of blood)
- Sidedness, (mostly anterior versus dripping down throat)
- Previous bleeding episodes and how they were treated
- History of anatomic abnormalities (e.g., septal perforation, septal deviation)
- History of allergy
- History of substance abuse (e.g., cocaine)
- History of foreign body insertion (especially relevant in children)
- History of trauma
- History of anticoagulation
  - Purpose for anticoagulation is critical (e.g., atrial fibrillation vs. mechanical heart valve vs. recent drug eluting stent)—will determine safety of stopping anticoagulation.
- Personal/family history of bleeding disorder

CLINICAL box

Blood in the Oropharynx

Blood in the oropharynx does not mean a posterior bleed. Usually patients will lean back, causing blood from the anterior septum to leak back into the nasopharynx and down the oropharynx.

Physical Exam

- Always start with ABCs, vitals (see above), patients can become unstable quickly
- If stable, inspect anterior septum after decongestion
  - Note areas of active bleeding, prominent vessels, septal deviation/perforation, etc.
- Inspect oropharynx for blood (see Clinical Box, Blood in the oropharynx)

Investigations

- Usually none necessary for mild bleed
- If severe, obtain CBC (particular attention to Hb and platelets), electrolytes, creatinine
- Obtain INR, PTT if anticoagulated or if bleeding disorder suspected
- Imaging usually not recommended

diagnosis

- Anterior epistaxis: usually diagnosed based on physical exam
- Posterior epistaxis: by definition this means bleeding that is not controlled by an adequate anterior pack. However, the majority of epistaxis that continues to bleed after packing is due to an ineffective anterior pack, rather than a posterior bleed.

Management (Figure 17.3)

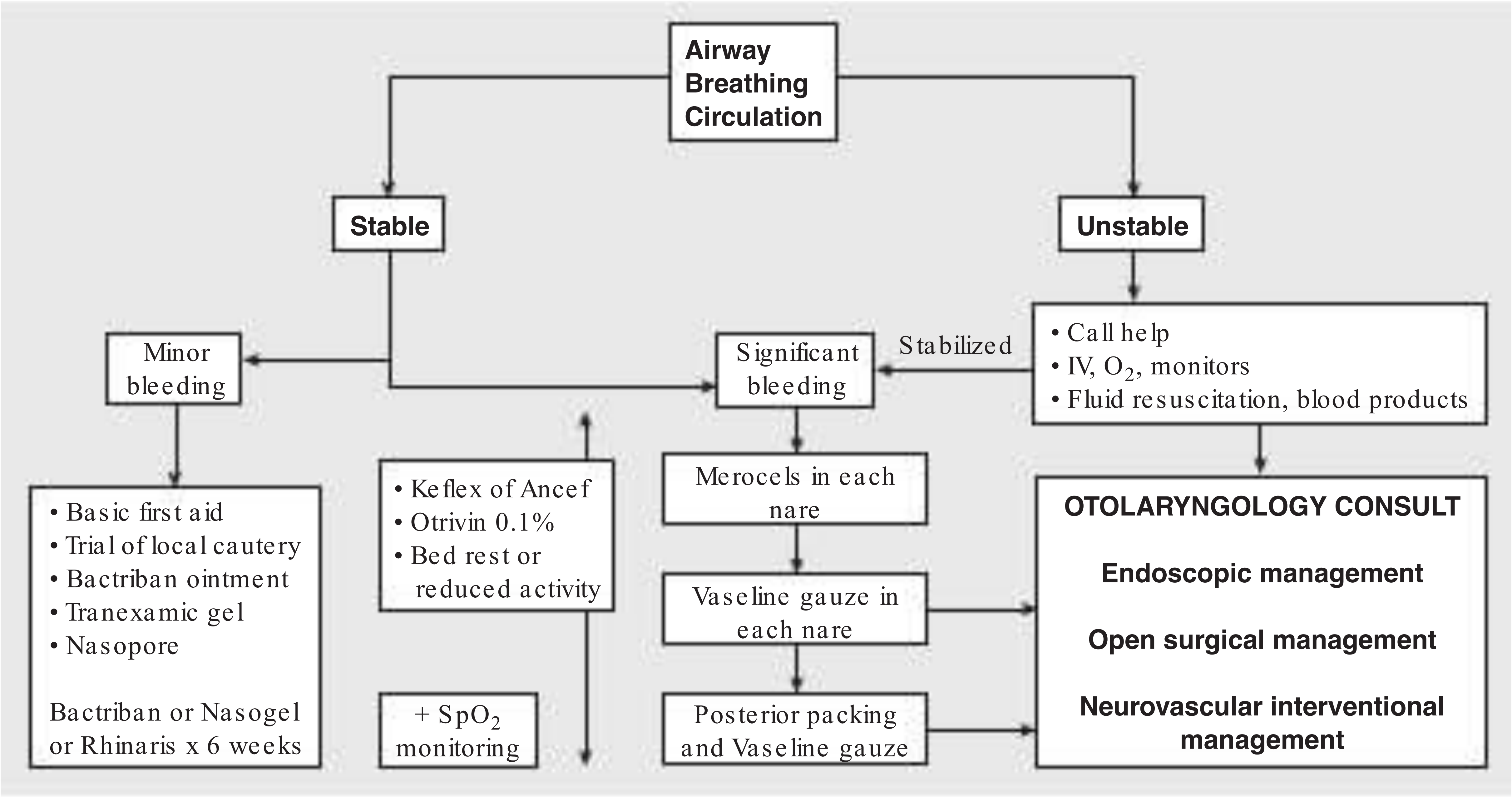


Figure 17.3. Management algorithm for epistaxis.

- Postepistaxis care:
  - Saline irrigation, humidified air, and Vaseline/Polysporin to anterior nares for a minimum of 60 d
  - Bed rest or light activity for 24 to 48 h
  - Remove rigid nasal packing (e.g., Merocel) in 48 to 72 h
  - Reversal of anticoagulation, if indicated
  - Referral to appropriate specialized care, if indicated

TINNITUS

MCC OBJECTIVE

Based on Objective #108 (Tinnitus) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Tinnitus is the perception of sound in the absence of external auditory stimuli. It is usually benign, but can significantly affect quality of life. In rare circumstances, it can be a symptom of serious underlying pathology.

- Subjective: only the patient can hear the noise (most common).
- Objective: sound can also be heard by the examiner (rare). Sound is caused by a para-auditory structure.

APPLIED SCIENTIFIC CONCEPT

The CNS is the generator of tinnitus in most cases. Perception of tinnitus is likely related to the loss of input (e.g., damage or injury to the cochlea) to neurons in the central auditory pathways. This results in abnormal firing of the neurons, which results in the perception of sound.

CAUSAL CONDITIONS (Table 17.4)

TABLE 17.4 • Causal conditions of tinnitus

Auditory				Para-auditory
External/Middle Ear	Cochlear-Vestibular	Cochlear Nerve	Brain Stem/Cortex	Pulse Synchronicity
• External otitis • Wax • Foreign body • Otitis media • Otosclerosis • Trauma	• Presbycusis • Drugs (ASA, aminoglycosides, loop diuretics) • Otosclerosis • Ménière disease • Noise, trauma, infections, idiopathic	• Tumor compression • Acoustic neuroma • CPA (cerebellopontine angle) lesion	• Vascular ischemia • Chiari malformation • Infections (meningitis) • Endocrine/metabolic (Paget, thyroid)	**Pulse synchronous** • Vascular (arterial bruits, hyperdynamic states, aneurysm, venous hum) • Glomus tumor **Nonpulse synchronous** • TMJ dysfunction, palatal myoclonus, whiplash

APPROACH (Figure 17.4)

History

- Determine quality and **laterality** of the tinnitus
  - Unilateral tinnitus is more likely to point to underlying pathology
- Determine presence of past ear diseases, prolonged noise exposure, and hearing function
- Pulsatile tinnitus is most commonly due to a vascular pathology, such as a vascular tumor or a tortuous carotid artery
- Identify possible aggravating factors
- Excess noise exposure is the most common cause of transient tinnitus
- Common medications: ASA, NSAIDs, aminoglycosides, and diuretics

!

UNILATERAL TINNITUS

Unilateral tinnitus, although usually benign, is more likely to point to an underlying pathology. CPA tumors can present in this way. If suspected, order an MRI of the head with gadolinium contrast. Head and neck cancer can also present in this way. If suspected, refer to an otolaryngologist for endoscopy.

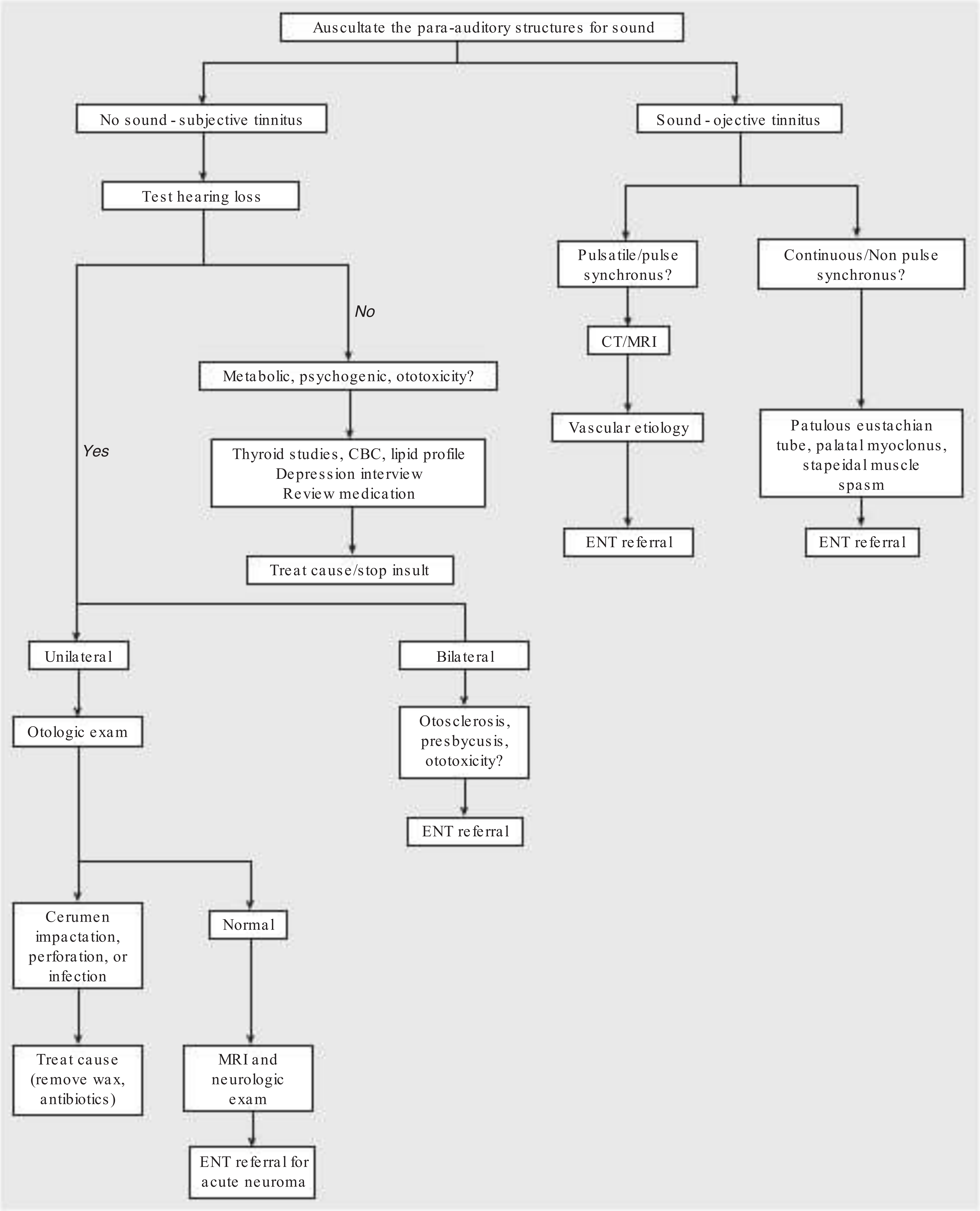

Auscultate the para-auditory structures for sound
No sound - subjective tinnitus
Sound - ojective tinnitus
Test hearing loss
No
Yes
Metabolic, psychogenic, ototoxicity?
Thyroid studies, CBC, lipid profile
Depression interview
Review medication
Treat cause/stop insult
Pulsatile/pulse synchronus?
CT/MRI
Vascular etiology
ENT referral
Continuous/Non pulse synchronus?
Patulous eustachian tube, palatal myoclonus, stapeidal muscle spasm
ENT referral
Unilateral
Otologic exam
Cerumen impactation, perforation, or infection
Treat cause (remove wax, antibiotics)
Normal
MRI and neurologic exam
ENT referral for acute neuroma
Bilateral
Otosclerosis, presbycusis, ototoxicity?
ENT referral

Figure 17.4. Tinnitus.

Physical Exam

- Perform an otoscopy to evaluate for a middle ear infection or cerumen impaction
- Look for a pulsatile mass behind the tympanic membrane
- Perform Weber and Rinne tuning fork tests (see Hearing Loss)
- Auscultate the head and neck region, including the carotid artery and thyroid gland, to identify a possible cause of objective tinnitus

Investigations

- Routine evaluation of tinnitus includes an audiogram.
- Imaging (MRI or CT temporal bones) can be indicated in some cases (see Red Flag Box, Unilateral Tinnitus).

diagnosis

- Most pathology can be ruled out on history and physical exam.
- Diagnosis of a CPA tumor is based on imaging.
- Diagnosis of a head and neck cancer requires direct visualization on endoscopy, imaging, and tissue biopsy (done by an otolaryngologist).
- Some middle and inner ear pathology can be diagnosed on audiogram.

Management (Figure 17.5)

- Simple procedures such as cerumen removal, myringotomy for a middle ear effusion, or cessation of ototoxic medications can help patients substantially.

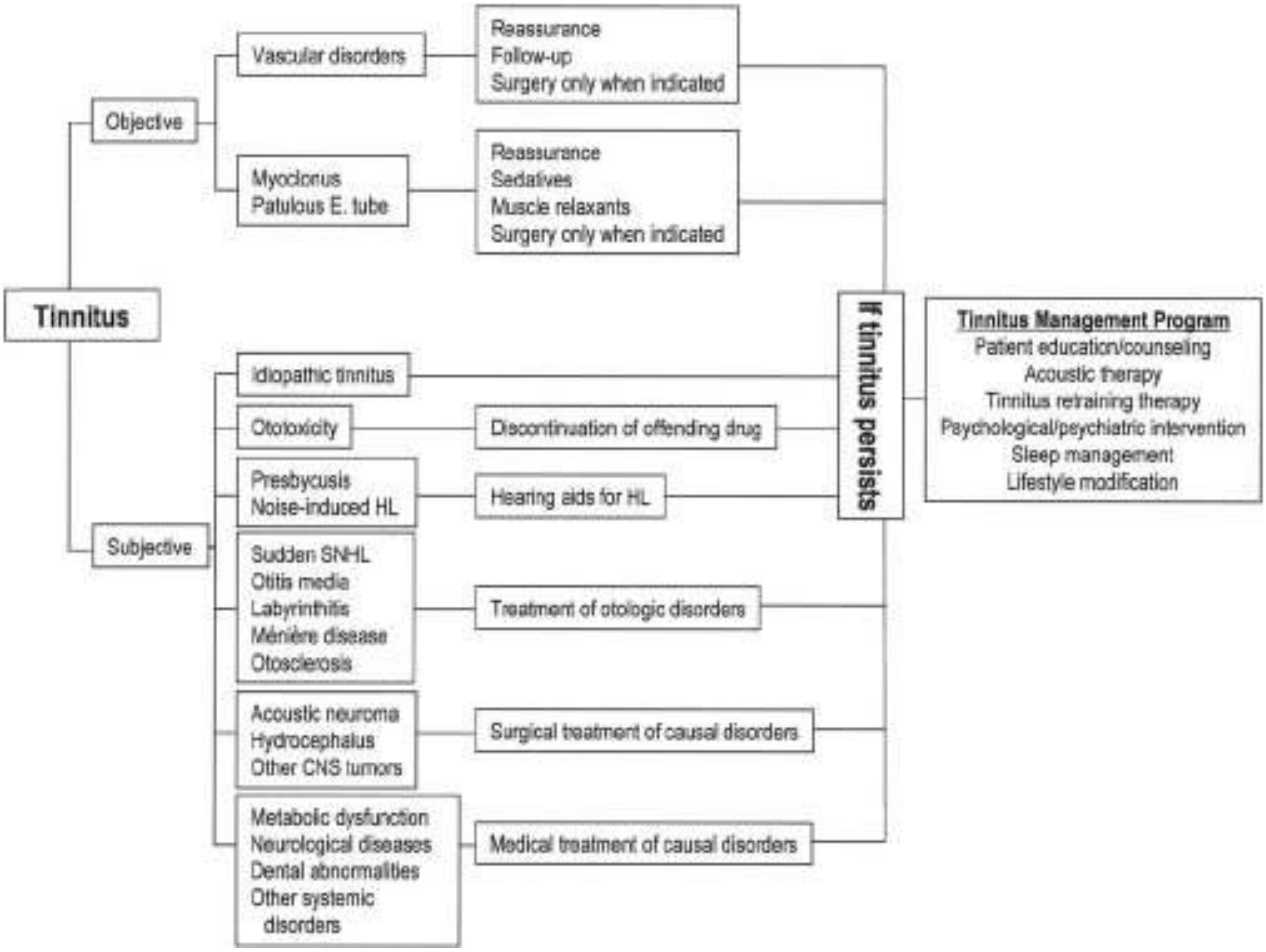


Figure 17.5. Management of tinnitus. (From Bailey BJ, Johnson JT, Newlands SD. Head & Neck Surgery—Otolaryngology. 4th ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2006.)

- Management of the symptom is met with inconsistent success. Hearing aids or white noise generators (maskers) can reduce tinnitus.
- Modalities such as biofeedback, acupuncture, and medications have not been consistently proven to be effective.
- Educate the patient and provide reassurance to the benign nature of this condition.
- Tinnitus support groups may help the patient cope with the psychological stress.

HEARING LOSS

MCC OBJECTIVE

Based on Objective #40 (Hearing Loss and Deafness) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Hearing loss is a common complaint and can significantly affect quality of life. Many causes are harmless and reversible if treated. Hearing loss can be a sign of serious underlying pathology.

CLINICAL box

Common Causes of Hearing Loss

The most common cause of hearing loss in children is otitis media (OME or AOM).

The most common cause of hearing loss in adults is cerumen impaction, followed by presbycusis (age-related SNHL).

APPLIED SCIENTIFIC CONCEPT

- Sound waves travel through the external auditory canal to strike the tympanic membrane and vibrate the ossicles, known as the malleus, incus, and stapes. The energy is then transmitted to the oval window, which enters into the cochlea. The cochlea is the end organ of hearing and is divided into three fluid-filled compartments.
- The organ of Corti contains auditory hair cells and is located in the middle compartment of the cochlea. Vibrations of the stapes footplate against the oval window induce a fluid wave, which displaces these hair cells and, in turn, triggers neural activity in the cochlea. The culmination of neural signals from all hair cells are transmitted through cranial nerve VIII to the primary auditory cortex located in the temporal lobe of the brain.
- CHL results from interference of sound wave transmission from the external auditory canal to the cochlea. It represents a defect in the external or middle ear.
- SNHL is due to a defect of the cochlea or auditory neural pathways.

CAUSAL CONDITIONS (Tables 17.5 and 17.6)

TABLE 17.5 • Causal conditions of conductive hearing loss

External Ear	Middle Ear
• Obstruction ◦ Cerumen impaction ◦ Foreign body ◦ Exostoses ◦ Tumor • Developmental ◦ Microtia ◦ Canal atresia • Inflammation/infection ◦ Otitis externa	• Ossicles ◦ Otosclerosis ◦ Ossicular discontinuity • Inflammation/infection ◦ AOM ◦ Otitis media with effusion • Mass ◦ Cholesteatoma ◦ Glomus tympanicum • Developmental ◦ Atresia ◦ Malformation • Tympanic membrane ◦ Tympanic membrane perforation ◦ Tympanosclerosis

TABLE 17.6 • Causal conditions of sensorineural hearing koss

Cochlea	Central	Congenital

• Presbycusis
• Noise-induced
• Ototoxic medications
  ◦ Aminoglycosides
  ◦ Chemotherapy agents
  ◦ Loop diuretics
• Ménière disease
• Trauma
  ◦ Temporal bone trauma
  ◦ Perilymphatic fistula
  ◦ Barotrauma
	• CPA tumors (vestibular schwannoma)
	• Auditory neuropathy
	• MS
		• Hereditary
		  ◦ Nonsyndromic (70%)
		  ◦ Syndromic (30%)
		• High-risk birth
		  ◦ TORCH infection
		  ◦ Perinatal anoxia
		  ◦ Birth trauma
		  ◦ Low birth weight
		  ◦ Kernicterus

APPROACH

History

- Onset, laterality, severity, duration of hearing loss (see Red Flag Box, SSNHL)
- Ask about common inciting factors: excessive noise exposure, trauma, ototoxic medications
- Other otologic symptoms: vertigo, tinnitus, otalgia
- In children, birth history for congenital hearing loss is important: perinatal hypoxia, infections, and maternal infections
- AOM: otalgia, fever, hearing loss. Infants can present with nonspecific symptoms (e.g., ear-tugging, poor sleep, irritability, decreased appetite)
- Presbycusis: elderly patients with progressive hearing loss with specific difficult with speech discrimination in the setting of loud background noises

SUDDEN SENSORINEURAL HEARING LOSS

!

Sudden onset unilateral hearing loss with a normal physical exam is SSNHL until proven otherwise. This can be permanent and debilitating. Immediate treatment with steroids ± antivirals and referral to an otolaryngologist are indicated.

Physical Exam

- Standard otologic exam:
  - Assess tympanic membrane (position, color, translucency, mobility)
  - Assess external auditory canal (cerumen impaction, otitis externa)
- Tuning fork tests (Weber and Rinne; Table 17.7)

TABLE 17.7 • Tuning forks test to differentiate conductive and SNHL

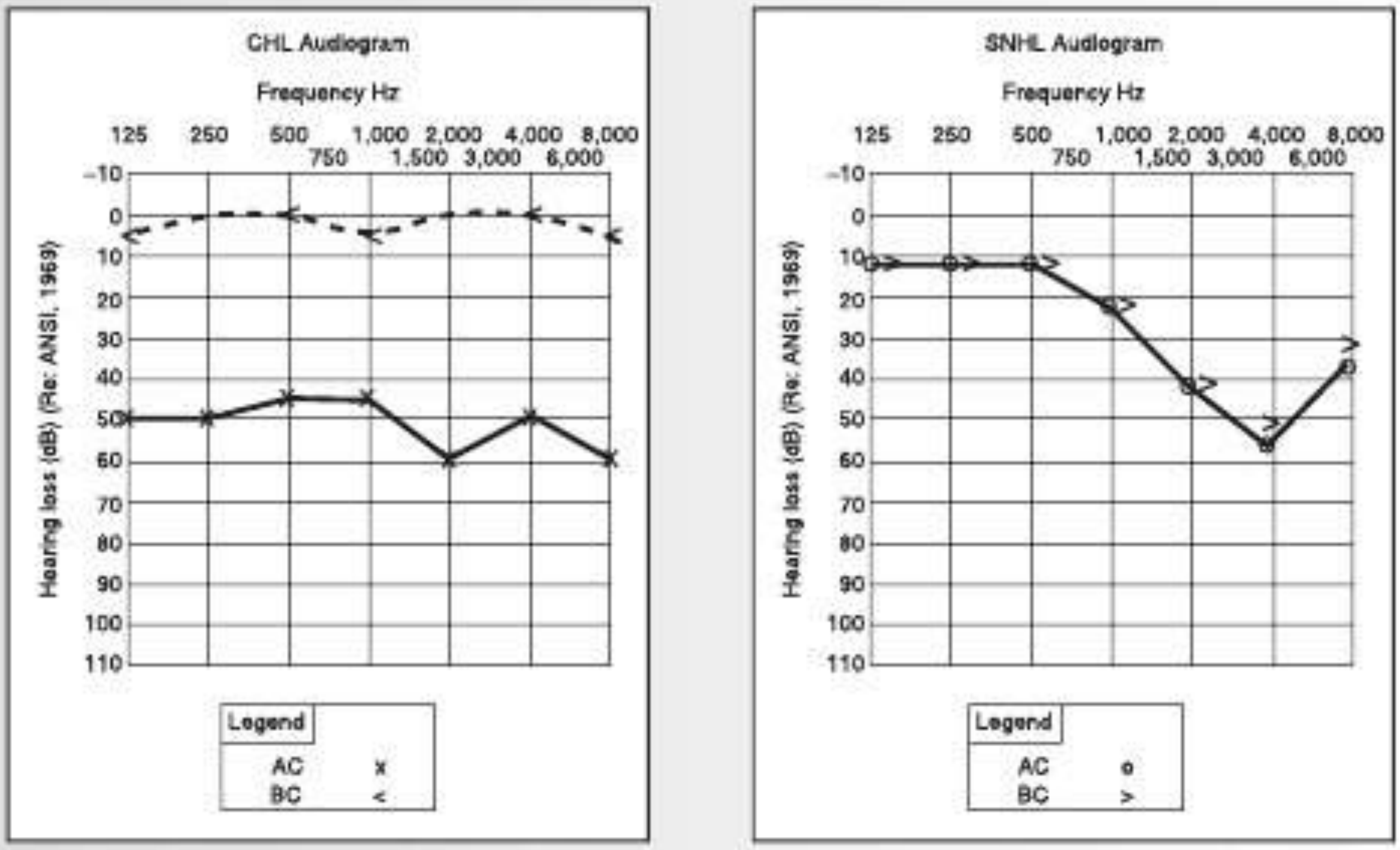
Rinne test	Weber
• A 512-Hz tuning fork is struck and firmly pressed against the mastoid process. This tests BC. • The tuning fork is then replaced beside the external auditory canal to examine AC. • If AC is noted to be louder than BC, the subject has normal hearing or SNHL. Conversely, if a patient reports that BC > AC, he or she has CHL.	• A 512-Hz tuning fork is struck and held on the vertex of the head. • The patient is asked if the sound is heard centrally or lateralizes to one side. • Sound lateralizes toward an ear with a CHL, and away from the side with SNHL.

Investigations

- Audiogram is often necessary unless there is a clearly identifiable, reversible cause (e.g., AOM, cerumen impaction)
  - Can elucidate severity and type of hearing loss, and can often suggest a cause (Figure 17.6)
- Imaging (e.g., CT temporal bones) may be indicated if specific pathology is suspected.

Management

- Aimed at specific diagnosis/underlying cause
- AOM/otitis externa: see Otalgia



- BC thresholds (<) are normal, and therefore, sensorineural hearing is perfectly intact.
- AC thresholds (x) are significantly increased.
- The difference between AC and BC is called an air-bone gap.
- Air-bone gap > 15 dB signifies CHL

- The BC (>) thresholds are raised, indicating an sensorineural hearing impairment. There is no air-bone gap, and therefore, no CHL exists.

Figure 17.6. Hearing tests to differentiate conductive and SNHL

- Prevention: protection from excessive noise exposure (e.g., ear plugs), avoidance of ototoxic medications
- Hearing aids: many types are available for both CHL and SNHL. Referral to an audiologist is indicated.

SORE THROAT / RHINORRHEA

MCC OBJECTIVE

Based on Objective #100 (Sore Throat and/or Rhinorrhea) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Coexistence of rhinorrhea (runny nose) and pharyngitis (sore throat) often suggests URTI such as the common cold. Pharyngitis may be due to viral and bacterial pathogens. Infections are transmitted through direct contact with infected bodily fluids, such as saliva or nasal secretions. Rhinorrhea may be acute, seasonal, and chronic. It is most commonly due to URTIs, sinusitis, and rhinitis.

APPLIED SCIENTIFIC CONCEPT

The most common agents responsible for a sore throat are adenovirus, EBV, and GAS. Specifically, it is crucial to determine if GAS is the etiologic factor, as it is associated with specific complications, namely glomerulonephritis and rheumatic fever, and requires a course of Abx.

CAUSAL CONDITIONS (Table 17.8)

TABLE 17.8 • Causal conditions of pharyngitis and rhinitis

Pharyngitis			Rhinitis
Viral	**Bacterial**	**Other**	**Allergic Rhinitis**
Adenovirus	GAS	Mycoplasma	Idiopathic rhinitis
Rhinovirus	Group C and G streptococcus	Candidiasis	Sinusitis
Influenza/parainfluenza	N. gonorrhoeae		CSF leak
Coxsackie	C. diphtheriae		Foreign body
HSV			
EBV			
CMV			

APPROACH

History

- Onset, progression of symptoms
- Ask about other infectious symptoms (e.g., rash, fever, GI symptoms, etc.)
- Pharyngitis:
  - Major task is to determine if GAS is the pathogen.
  - The presence of rhinorrhea and cough and absence of fever make the diagnosis of GAS infection less likely. Such patients are most likely to have a viral URTI, and do not require further testing or interventions.
  - Sore throat score can aid in diagnosis (Table 17.9).

TABLE 17.9 • Sore throat score in diagnosis of GAS pharyngitis

Symptom	Points
Cough absent?	1
History of fever > 38°C?	1
Tonsillar exudates?	1
Swollen, tender anterior nodes?	1
Age 3–14?	1
Age 15–44?	0
Age > 45?	−1
Score	**Recommended action**
0–1	No culture or abx
2–3	Culture all, abx only if culture is positive
4	Culture all, treat with abx, discontinue to cultures negative

Centor RM, Witherspoon JM, Dalton HP, et al. The diagnosis of strept throat in the emergency room. Med Decis Making. 1981;1(3):239–246.

- Rhinorrhea:
  - Allergic rhinitis (hay fever) affects up to 20% of individuals. There is often a personal and family history of atopy, such as asthma or eczema. It is usually seasonal, and patients also complain of nasal or ocular itching.

  - Idiopathic rhinitis, or vasomotor rhinitis, is characterized by watery nasal discharge and intermittent congestion that is induced by nonspecific irritants, such as temperature changes or spicy foods.
  - Sinusitis leads to nasal obstruction, facial pain, and purulent nasal discharge.

Physical Exam

- Examine the nasal cavity with a nasal speculum:
  - Clear versus purulent nasal discharge
  - Mucosal congestion
  - Specifically should rule out nasal polyps or malignancy

Investigations

- The rapid antigen detection test (**RADT**) is useful as an initial screen for GAS. While the specificity of RADTs exceeds 95%, the sensitivity varies between 65% and 90%.
- If the RADT is positive, the diagnosis is reliable and treatment should be initiated. A negative RADT could have a 10% to 35% false-negative rate. As such, the clinician must wait for the throat culture results to confidently rule out GAS.

Diagnosis

- Poststreptococcal glomerulonephritis
  - Elevated antistreptolysin O quantitative titer
  - RBC casts on urinalysis
- Acute rheumatic fever
  - Clinical diagnosis is based on evidence of antecedent pharyngeal GAS infection and Jones criteria (two major, or one major and two minor).
    - Major criteria: carditis, polyarthritis, chorea, erythema marginatum, subcutaneous nodules
    - Minor criteria: arthralgia, fever, elevated ESR, elevated CRP, prolonged PR interval on ECG

Management

- See CanMED Box
- GAS pharyngitis is treated with a 10 day antibiotics course. The recommended antibiotic is **penicillin V** in adults and **amoxicillin** in children.
- Antibiotics prevent the development of acute rheumatic fever, but do not decrease the incidence of glomerulonephritis.
- Incidence of GAS transmission in untreated patients to close contacts is 35%. However, within 24 h of penicillin administration, the patient becomes minimally contagious. If a close contact experiences pharyngitis, there is a higher likelihood of the causative agent being GAS and should be managed accordingly.

Manager: antibiotic overuse

- Acute pharyngitis is one of the most common presenting complaints to the physician's office.
- While the most clinically important pathogen is GAS, this is the causal agent in < 10% of cases. However, up to 75% of adults with acute pharyngitis are prescribed Abx.
- The overtreatment of pharyngitis with Abx against the established practice guidelines is a major cause of Abx abuse, leading to bacterial resistance and unnecessary health spending.

SMELL AND TASTE DYSFUNCTION

MCC OBJECTIVE

Based on Objective #100-1 (Smell/Taste Dysfunction) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Disorders of taste and smell are common occurrences. Approximately 80% of taste problems are actually secondary to disorders of smell. These can be divided into conductive and sensorineural causes. Total loss of taste rarely occurs due to neural cross-innervation.

APPLIED SCIENTIFIC CONCEPT

Taste buds are globular clusters of cells located on the tongue papillae containing microvilli within a taste pore. The glossopharyngeal nerve (CN IX) supplies taste and general sensation to the posterior one-third of the tongue. The chorda tympani nerve (branch of CN VII) supplies taste to the anterior two-thirds of the tongue. Olfactory receptors are located in the cribriform plate, and are carried to the brain via the olfactory nerve (CN I).

CAUSAL CONDITIONS (Table 17.10)

TABLE 17.10 • Causal conditions of smell and taste dysfunction

Conductive	Sensorineural
The odor cannot reach the olfactory epithelium secondary to nasal obstruction.	Central neural structures cannot interpret the neural transmission.
Inflammatory Allergic rhinitis Vasomotor rhinitis Nasal polyps	Degenerative Stroke Alzheimer disease Parkinson disease MS
Nasal cavity neoplasms	Endocrine/metabolic Diabetes mellitus Adrenal hypo/hyperfunction Pseudohypoparathyroid Hypothyroid Renal failure Hepatic failure
Congenital Septal deformity Choanal atresia	Intracranial neoplasms
Other Foreign body	Other Chemicals Drugs Head trauma

APPROACH

History

- Onset, time course of dysfunction:
  - Sudden onset of smell or taste dysfunction could represent viral infection.
  - Gradual loss suggests allergic rhinitis, nasal polyposis, or neoplasms.
  - Intermittent disruption of function favors the diagnosis of allergic rhinitis.
- Ask about neoplastic red flag symptoms (e.g., dysphagia, odynophagia, otalgia, voice changes, fever/chills/weight loss)
- Ask about infection symptoms (sore throat, rhinorrhea, purulent nasal discharge, etc.)
- Personal or family history of atopy
- Ask about neurologic symptoms indicative of central disease

Physical Exam

- Examine the oral cavity and oropharynx:
  - Look for erythema, masses, ulcerations, leukoplakia, erythroplakia
- Examine the nasal cavity:
  - Rule out common causes of nasal obstruction such as nasal polyps, edematous mucosa due to rhinitis
  - Examine for nasal masses/neoplasms
- Perform a complete neurologic exam with specific attention to cranial nerves

Investigations

- If the patient complains of chronic nasal obstruction and purulent discharge, obtain a CT scan of the paranasal sinuses to evaluate for sinusitis, polyps, or intranasal masses
- Routine blood work is not indicated, but the clinician may elect to order blood tests to examine for diabetes mellitus, thyroid, and renal function.

Management

- The treatment of smell or taste dysfunction is directed at the causative factor.
- If nasal congestion or nasal polyposis is present, consider intranasal corticosteroid sprays

NEUROLOGIC DEFICITS

Any neurologic signs or symptoms warrant an MRI to rule out intracranial pathology, such as a tumor or stroke.

CLINICAL box

Samter Triad - for Aspirin sensitive asthma

Nasal polyposis, asthma, and ASA sensitivity

- Treatment of acute sinusitis consists of abx and saline irrigation.
- Polyps and sinus disease that are refractory to medical treatment warrant an otolaryngology consultation for surgical intervention.

MOUTH PROBLEMS

MCC OBJECTIVE

Based on Objective #60 (Mouth Problems) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Two of the most common diseases affecting the mouth are odontogenic infections and neoplasia.
- Periodontal diseases affect 15% of the population and have potentially serious complications.
- Oral neoplasms are difficult tumors to treat, and signs of oral malignancy must be recognized early.

APPLIED SCIENTIFIC CONCEPT

- There are two main types of dental infections: dental caries and periodontal disease, both of which arise from bacteria that colonize the teeth surface.
    - Dental caries are caused by bacteria within the plaques, which produce acid. The acid generated on the surface of the tooth by these bacteria demineralizes the enamel coating, and helps the bacteria invade the pulp.
    - Bacterial plaques located below the gingival margin may lead to periodontal disease, which is defined as infection of the gum, ligaments, and bones that support the teeth.
- Dental infections that invade through the mandible or maxilla may spread through various fascial planes to cause life-threatening complications, such as sepsis or airway compromise.
- Predisposing factors for odontogenic infections include poor dental hygiene and advanced age, with associated gingival recession. Other predisposing factors include hormonal changes, such as that during puberty or pregnancy, and systemic illnesses that impair the immune system.

CAUSAL CONDITIONS (Table 17.11)

APPROACH

History

- Patients with dental disease often present with pain and hypersensitivity to temperature and air.
- Important questions include those pertaining to cancer risk factors:
    - Tobacco use (smoking or chewing)
    - Alcohol (works synergistically with tobacco to dramatically increase the risk of cancer)
    - Radiation
- Social history can be important (Patients with low socioeconomic status are predisposed to poor dental health and dental infections.).

Physical Exam

- Inspect and palpate the oral cavity and oropharynx:
    - Look for leukoplakia, ulcers, and asymmetric masses
    - Exam may reveal grossly decayed teeth with erythematous gingiva.
- Suspicious appearing tumors warrant urgent referral to an otolaryngologist.

Investigations

- Panorex x-ray can be useful in the workup of dental caries, and odontogenic cysts and abscesses.
- Lesions suspicious for malignancy or deep neck space infection warrant CT soft tissue neck with contrast enhancement.
    - Remember that the teeth themselves are not well assessed by CT due to artifact.

TABLE 17.11 • Causal conditions of mouth problems

Children	Adults	Elderly
• Teeth abnormalities ◦ Caries ◦ Eruption • Gingival overgrowth ◦ Idiopathic, genetic, drugs • Trauma ◦ Abuse ◦ Accidents	• Periodontal infections ◦ Dental caries/endodontic infection/periapical abscess ◦ Gingivitis/periodontitis/pericoronitis/periodontal abscess ◦ Fascial space infections/osteomyelitis • Oral carcinoma ◦ Premalignant ◦ Leukoplakia/erythroplakia ◦ Squamous cell carcinoma ◦ Malignant • Salivary glands ◦ Infections (mumps, bacterial) ◦ Sialolithiasis-calcified mass forms in salivary gland. ◦ Tumor • Other ◦ Cellulitis ◦ Trauma ◦ Candida	• Receding gingival/gums • Edentulism

Management

- The main bacterial pathogens are various serotypes of *S. mutans*. Lactobacilli are progressive agents due to their acid-producing ability. In acute odontogenic infections, especially periodontal disease, systemic antimicrobials are of benefit.
  - Abx: penicillin, ampicillin-sulbactam, and clindamycin
- Strategies to prevent odontogenic infections include regular teeth brushing with fluoride toothpaste, flossing, topical antiseptics (i.e., chlorhexidine), and dietary changes to decrease sugar consumption.
- The most significant public health change in decreasing dental caries has been the fluoridation of water supplies.

ODONTOGENIC ABSCESS/ DEEP NECK SPACE INFECTION

If a patient presents with evidence of complications from a tooth infection, such as neck swelling, trismus, hoarseness, or stridor, an urgent consultation to an otolaryngologist is warranted for definitive management.

NECK MASS

MCC OBJECTIVE

Based on Objective #63 (Neck Mass, Goiter, Thyroid Disease) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Many systemic and local diseases have manifestations in the neck, and as such the differential diagnosis for a neck mass is very broad. The age of the patient plays a critical role in establishing a diagnosis as childhood neck masses tend to be congenital, masses in young adults tend to be inflammatory, and the risk of malignancy increases significantly with increasing age.

APPLIED SCIENTIFIC CONCEPT

The anatomy of the neck is intricate and complex, but certain broad anatomic subunits are helpful in establishing a diagnosis. The neck is often divided into anatomic triangles:

- Anterior cervical triangle (boundaries = midline of the neck, posterior border of SCM, inferior border mandible)

  - Contains the submandibular, submental, carotid, and muscular triangles
- Posterior cervical triangle (boundaries = clavicle, posterior border of SCM, anterior border of trapezius)
  - Contains occipital and supraclavicular triangles
  - Many important structures lie in the posterior triangle, including the pleural apices, phrenic nerve, brachial plexus trunks, subclavian artery and vein, and spinal accessory nerve.

Lymph node levels of the neck are also extremely important, particularly for malignant/metastatic neoplasms:

- Level I: submental and submandibular nodes
- Level II: cervical nodes from skull base (superior) to level of hyoid bone (inferior)
- Level III: cervical nodes from level of hyoid bone (superior) to inferior border of cricoid (inferior)
- Level IV: cervical nodes from inferior border of cricoid (superior) to root of neck
- Level V: posterior triangle
- Level VI: central compartment lymph nodes bounded by carotids (laterally), hyoid (superiorly), suprasternal notch (inferiorly)

CAUSAL CONDITIONS (Table 17.12)

TABLE 17.12 • Differential diagnosis of neck masses (most common)

Congenital	Infectious/Inflammatory/Systemic	Endocrine	Neoplastic
Branchial cleft cyst	Bacterial/viral lymphadenitis	Thymic cyst	Metastatic or regional malignancy
Lymphatic malformation	Tuberculosis	Thyroid hyperplasia	Thyroid neoplasm
Teratoma/dermoid cyst	Cat-scratch disease	Aberrant thyroid tissue	Lymphoma
Thyroglossal duct cyst	Syphilis	Parathyroid cyst	Hemangioma
External laryngocele	Atypical mycobacteria		Salivary gland tumor
	Persistent generalized lymphadenopathy		Vascular tumor
	Mononucleosis		Neurogenic tumor
	Sebaceous cyst		Lipoma
	Abscess		
	Granulomatous disease		
	Plunging ranula		
	Kawasaki disease		

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NECK MASSES AND THE AIRWAY

Some neck masses (e.g., abscesses, large neoplasms) can cause airway compromise. Always ensure the patient is stable and has a secure airway before proceeding with a history/physical exam. Some slow-growing malignancies can almost entirely occlude the airway before causing the patient symptoms.

APPROACH

History

- Onset (sudden vs. gradual), duration, progression of neck mass
- Associated symptoms such as pain, drainage, skin changes
- Infectious symptoms (fever, rhinorrhea, sore throat, otalgia)
- Always ask about voice changes, stridor, dysphagia, dyspnea, otalgia (may point to malignancy)
- Preceding/contributing factors: recent URTI, otitis media, other head and neck infection, exposure to pets/animals, exposure to TB, recent trauma (including small nicks cause by shaving, etc.), immunodeficiency
- Ask about B symptoms/risk factors for lymphoma: fever, chills, night sweats, weight loss, decreased appetite, family history
- Head and neck cancer risk factors: smoking, EtOH abuse
- Thyroid cancer risk factors: radiation history, smoking, family history, ethnicity

Physical Exam

- **ABCs** (see Red Flag Box, Neck Masses and the Airway) → airway may be compromised with large neck masses.

- Inspection: look for obvious neck mass or goiter, listen for stridor/hoarseness, look for skin changes (erythema, drainage, necrosis)
- Palpation: size (normal hyperplastic nodules are very rarely > 2 cm), number and distribution, consistency (hard, soft, compressible, fluid-filled), mobility, tenderness, fixed to underlying structures?
- Categorize the mass into midline versus lateral, neck level, anatomic triangle
- Does mass rise with swallowing? (suggests thyroid); does it rise with tongue protrusion? (suggests thyroglossal duct cyst)
- Make sure to perform a full head and neck exam with special attention to oral cavity/oropharynx for masses
- Check for other areas of lymphadenopathy (axillary, inguinal, etc.) if lymphoma or systemic disease suspected
- Check for other manifestations of Graves disease/hyper/hypothyroidism if these are suspected

Investigations

Investigations should be tailored to the suspected diagnosis.

- Blood work: CBCs useful for infectious causes and suspected lymphoma. Monospot, HIV testing, cat-scratch antigen titers, and EBV serology may be helpful. TSH is warranted for suspected thyroid disease such as Graves.
- CT soft tissue neck with contrast: good visualization/differentiation of abscesses, neoplasms, vascular lesions, etc.
- Ultrasound: useful especially in children who will not tolerate CT. Good visualization of cystic and vascular lesions. Thyroid ultrasound is useful for suspected thyroid masses.
- FNA: for suspicious thyroid nodules, suspected malignancy with unknown primary
- Open biopsy: if lymphoma suspected

diagnosis

- History and physical exam will significantly narrow the diagnosis, usually to one category and often to only a few possibilities.
- If the history and physical exam are consistent with a benign cause such as reactive lymphadenopathy (in the absence of cancer risk factors), no further investigation is needed to make the diagnosis.
- Definitive diagnosis of congenital and neoplastic masses often required appropriate imaging and/or tissue biopsy.

Management

- No management is required for the majority of neck masses in young patients, as they are usually reactive benign lymph nodes.
- If malignancy is suspected, urgent referral to an otolaryngologist is warranted.
- Patients with congenital masses (e.g., branchial cleft cyst, thyroglossal duct cyst) should also be referred for surgical evaluation. These masses, although benign, can become infected and cause significant impact on quality of life.

Chapter

18

Pediatrics

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NEWBORN ASSESSMENT

MCC OBJECTIVE

Based on Objective #74-1 (Newborn Assessment) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- The primary care provider plays an important role in monitoring the health, growth, and development of infants.
- Routine assessments of newborns and infants allow for early identification of disease, decreasing morbidity and mortality.
- Caregiver reassurance and anticipatory guidance are fundamental to the role of physicians caring for infants as strategies to educate new parents on newborn care, promote health, and prevent injury.

APPLIED SCIENTIFIC CONCEPT

- Many complex physiologic and biochemical changes must successfully occur for newborns to transition to extrauterine life, making the neonatal period one of great vulnerability.
- Prematurity, congenital anomalies, infections, perinatal hypoxia, and adverse events during labor and delivery may jeopardize this transition and predict neonatal instability and the need for resuscitation.

APPROACH

History

- Maternal Hx: age, preexisting physical and mental health conditions, ABO group, and Rh status
- Maternal reproductive Hx: blood group sensitization, "GTPAL," including previous pregnancies, preterm deliveries, abortions (spontaneous or therapeutic)
- Pregnancy Hx: degree of antenatal care, serologies and GBS status, pregnancy-related medical conditions, medications, illicit drug use, smoking or EtOH, results of ultrasounds/screening tests/fetal assessments, antepartum bleeding, hospitalizations/ER visits

CLINICAL box

Recommended Timeline of Assessment

- Within 1 wk postdischarge (if newborn exam completed)
- Year 1: 2, 4, 6, 9, 12 mo of age
- Year 2: 15, 18, 24 mo

CLINICAL box

Vitamin D

All exclusively breast-fed infants should receive supplemental vitamin D, at minimum 400 IU/d.

- Labor and delivery Hx: gestational age, length of labor and rupture of membranes, intrapartum maternal fever and/or antibiotics, mode of delivery, complications, meconium in amniotic fluid, status of newborn immediately after birth (Table 18.1), resuscitation measures, need for NICU care, length of stay in hospital, birth weight (BW)

TABLE 18.1 • The Apgar score

	Score		
Parameter	0	1	2
Heart rate	Absent	↓ 100 bpm	↑ 100 bpm
Respiratory effort	Absent	Weak cry, hypoventilation	Good effort, crying
Muscle tone	Flaccid	Some flexion	Well flexed, active
Reflex irritability	No response	Grimace	Cry/cough/sneeze or withdrawal
Color	Blue/pale	Acrocyanotic	Completely pink

- Feeding Hx: method (breast vs. bottle), type (breast milk vs. formula), quantity (frequency/duration of feeds, volumes, change in breast fullness during feeds), infant's behavior during feeding (latch, suck, interested, falls asleep, arching/turning away from breast), regurgitation/choking with feeds, use of vitamin D or other supplements
- Output Hx: passage of meconium, frequency of stooling and voiding (number of wet diapers), color and consistency of stool
- Review of systems: fevers, jaundice, irritability, lethargy, jittery, cyanotic spells
- Sleep Hx: position, sleep environment, schedule
- Development: moves all 4 extremities, primitive reflexes
- FHx: congenital anomalies, intellectual disability, childhood illness or sudden death, genetic conditions, hereditary disease, parental ages, ethnicity, consanguinity, pedigree
- Psychosocial Hx: maternal adjustment, maternal depression and/or anxiety, home environment (including smoking, violence), caregivers, family supports, socioeconomic status

physical Exam (Table 18.2)

- Initial assessment of infant should take place within the first 24 h of life.

CLINICAL box

Breast-feeding Advice

- Exclusive breast-feeding recommended for first 6 mo
- Mother's diet should be balanced and can follow Canada's Food Guide.
- EtOH and recreational drugs will enter breast milk—other drugs and medications vary.
- Contraindications to breast-feeding are HIV, active TB (until 2 wk of appropriate therapy is complete), chemotherapy/nuclear medicine, high-dose metronidazole (for 12–24 h after dose), illicit drug use

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- Newborns should not sleep through the night; they should be fed approximately every 3 h (more frequent if premature, loss of > 10% birth weight)

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Delayed passage of meconium (> 24 h after birth) in a term baby could be suggestive of underlying pathology, including:

- Hirschsprung disease
- Meconium plug/ileus
- CF
- Anal stenosis
- Anal atresia

TABLE 18.2 • Newborn physical exam and physical findings

Body Part/System	Features	Red Flags	Investigations/Management/DDx
General appearance	Color, spontaneous movements, level of activity	Jaundice in the first 24 h of life	Bilirubin (total, direct, indirect), DAT (Coombs test), ABO group (if the mother is blood group O), minor group antigen screen, Rh status (and if RhoGAM was given), assessment for SSx of sepsis with consideration of FSWU
		Jaundice ↑ 24 h of life	As above + additional tests as indicated by risk factors (i.e., G6PD deficiency), assessment of feeding and hydration status (percentage of weight loss from birth), signs of birth trauma (e.g., cephalohematoma, visible bruising)
		Central cyanosis	Provide respiratory support as needed (supplemental oxygen, PPV, etc.), evaluate pre- and postductal saturations, consider underlying genetic condition (inspect for dysmorphic features)
		Pallor	Must rule out anemia, asphyxia, shock, edema, blood loss into the head from birth trauma

TABLE 18.2 • Continued

Body Part/System	Features	Red Flags	Investigations/Management/DDx
Growth parameters	Birth weight (BW)	Small for Gestational Age: BW < 10th percentile for age Large for Gestational Age: BW > 90th percentile for age	See abnormal weight in newborn
	Early weight changes (Weight loss is expected within first few days of life.)	Loss of > 10% of BW in first 7 d of life Failure to regain BW by 10 d of life	Assess feeding patterns and feeding relationship with mother, potential difficulties feeding as above Frequent reassessment of weight
	Birth length	Plots to extremes of growth curves	Consider endocrinologic/genetic evaluations, especially if abnormal weight-for-length, dysmorphic features/congenital anomalies, abnormal neurologic exam, suspicious FHx, etc.
	Head circumference	Microcephaly: > 2 SD below mean (< 3 percentile) for gestational age Macrocephaly: > 2 SD above mean (> 97th percentile) for gestational age	Consider evaluation for following, especially if other anomalies or impairments, neurologic symptoms, worsening or disproportionate microcephaly: neuroanatomic abnormalities, chromosomal abnormalities/syndromes, metabolic/endocrine disorders, environmental insults (congenital or perinatal infection, toxin exposure, perinatal hypoxia)
			Assess for signs/symptoms of increased ICP, neuromotor assymetry or abnormalities, syndromic features; measure parental head circumferences. Measure other growth parameters and obtain through Hx and FHx. Further evaluation may be warranted depending on findings.
Head and neck	Anterior/posterior fontanelles: size, open vs. closed	Sunken	Assess hydration status, vitals for hemodynamic stability, rule out sources of shock
		Bulging	Assess for other signs of increased ICP, fever, signs of meningitis, neurologic deficits: often warrants head U/S, CBC, blood/urine cultures, glucose, electrolytes, urea, creatinine; consider transfer to tertiary center with pediatric transport team support
		Large	Etiologies: syndromic, hydrocephalus, metabolic, endocrine, IUGR, normal variant
	Birth trauma involving facial or scalp soft tissues—subgaleal hemorrhage, caput succedaneum, cephalohematoma	(Listed from most benign to most worrisome) Caput succedaneum: diffuse edema (may cross midline and suture lines), may be ecchymotic Cephalohematoma: limited to surface of one cranial bone, no overlying discoloration, firm tense mass with palpable rim, presents after birth with gradual ↑ in size Subgaleal hemorrhage: firm, diffuse, fluctuant mass that ↑ in size after birth	Be wary of subgaleal hemorrhage (bleeding may be very extensive into large potential space beneath epicranial aponeurosis)—monitor with frequent vitals/assessments for perfusion, head circumference, and hypotension, hyperbilirubinemia, blood loss (Hct), or consumptive coagulopathy (DIC), may need transfer to tertiary care center for transfusions and volume resuscitation

(Continued)

TABl E 18.2 • Continued

Body Part/System	Features	Red Flags	Investigations/Management/DDx
	Red reflexes	White reflex (leukocoria), dark spots, absent reflex, asymmetric reflex	Urgent referral to an ophthalmologist to rule out tumor (e.g., retinoblastoma), cataracts, other pathology of lens, vitreous or retina
	Palate—normal vs. narrow vs. arched	Clefts of hard or soft palate by inspection (also, palpable submucosal cleft, associated with bifid uvula)	Cleft palate—requires referral to specialized center High-arched palate may be syndromic.
	Facial features	Multiple minor anomalies/ dysmorphic features	Consider referral to genetics
Cardiac	Heart sounds, murmurs (normal neonatal murmurs include persistent pulmonary flow murmur, transient systolic murmur related to closing PDA), extra sounds	Murmur, cyanosis, failure to thrive, tachypnea, diaphoresis with feeding Note: more likely to be pathologic murmur if: diastolic/pansystolic, harsh, radiation, no change with position, abnormal S_2	4-limb BPs, pre- (right arm) and postductal O_2 sats ECG, ECHO, referral to pediatric cardiologist
	Femoral pulses	Weak Brachial-femoral delay	Must rule out coarctation of aorta—4-limb BP, ECHO, cardiology consult
Respiratory	Respiratory rate	Effortless tachypnea	If ↑ RR with no ↑ WOB, must rule out CHF, acidosis, sepsis. Investigations include VBG, lactate, CXR; look for clinical signs of congenital heart disease and sepsis
	Work of breathing	↑—Retractions, nasal flaring, tracheal tug	Immediate attention: must investigate for signs of serious cardiopulmonary disease, sepsis. Consider CXR investigations as above
	Extra sounds	Expiratory grunting	
Abdo	Palpable masses: normal to palpable liver up to 2 cm below costal margin, spleen tip (less common)	Other palpable abdo masses	Immediate investigation with U/S to look for etiology (e.g., congenital malformation, hemorrhage, malignancy, cyst)
	Shape	Distension Scaphoid + respiratory distress	AXR to R/O obstruction (meconium ileus if shortly after birth), perforation CXR to R/O congenital diaphragmatic hernia
	Umbilical stump—signs of infection, 3 vs. 2 vessel cord	2 vessel cord (1 artery + 1 vein)	↑ Risk occult renal abnormality—monitor and consider need for U/S
Genitalia	Male: position of testes (inguinal canal vs. scrotum), position of urethral meatus (hypospadias, epispadias), palpable gonads	Ambiguous genitalia warrants prompt evaluation, and may be due to life-threatening etiology.	Refer to specialized team (see Ambiguous Genitalia section)
	Female: nonpurulent discharge normal, imperforate hymen—may have lower abdo mass	Clitoromegaly in females	Must rule out congenital adrenal hyperplasia—can be life threatening
Anus	Patency	Imperforate anus	X-ray as initial investigation, surgical management

TABLE 18.2 • Continued

Body Part/System	Features	Red Flags	Investigations/Management/DDx
MSK	Hips Hip click—can be normal, originates from fascia, and/or tendons	+ Barlow, + Ortolani	U/S to look for DDH
	Spinal alignment	Congenital scoliosis	Investigate associated pathologies—U/S for renal pathology, cardiac exam ± ECHO, MRI for possible intraspinal pathology
	Extremities	Abnormal number fingers and/or toes	Consider genetics consult if multiple anomalies
Dermatologic	Hair tufts/dimple	Present over lumbosacral spine	Investigate for underlying pathology (occult spina bifida, tumor, sinus tract). U/S as initial investigation.
	Normal neonatal rashes: erythema toxicum, pustular melanosis, dermal melanocytosis (Mongolian spots), harlequin color change		
Neurologic	Abnormal movements	Irrepressible movements, seizures	EEG + assessment by pediatric neurologist ± genetics/ metabolics. Consider MRI brain.
	Tone	Hyper/hypotonia	Pediatric neurology, genetics/metabolic consults
	Primitive reflexes (grasp, suck, Moro, ANTR)	Asymmetric Moro reflex	Clavicle fracture, brachial plexus injury (birth trauma), hemiparesis
		Absent Moro in term neonate	Suggests significant CNS dysfunction—full neurologic evaluation
		Obligatory ANTR (neonate becomes stuck in position)	

CLINICAL box

Vitals in the Normal Term Newborn

Weight: 3 to 4 kg

HR: 90 to 170 bpm

RR: 40 to 60 breaths/min

Systolic BP: 70 to 90 mm Hg

CLINICAL box

Growth Parameters

Weight, length, and head circumference should be measured and plotted on WHO growth charts for Canada at every visit.

Vital Signs

- See Clinical Box, Vitals in the Normal Term Newborn
- Definition of fever:
  - 38.0°C rectal
  - 37.3°C axillary
- Fever in a neonate **must** be evaluated with a full septic workup (CBC, blood C+ S, urinalysis, urine C+ S, lumbar puncture, ± CXR).

Investigations

- Routine newborn screening within the first 7 d of life (ideally first 2–3 d)
  - Details vary by province (e.g., inborn errors of metabolism, hemoglobinopathies, CF).
- Additional screening based on risk factors (i.e., if there is a Hx of sickle cell anemia, HIV, hepatitis) and any abnormalities on newborn physical exam (see Table 18.2)
- Routine hearing screening is recommended for all infants.
  - Hearing loss can irreversibly and negatively affect literacy, language, cognition, and psychosocial skills in a duration-dependent manner.
- All infants: assessment of jaundice (± serum bilirubin) and feeding within 24 h of life

Management

- Specific management is guided by the physical exam findings and risk factors.

Anticipatory Guidance

- Umbilical cord care
  - Expect detachment 1 to 3 wk after birth, keep clean and dry, and wash with water only
- Safe sleep and SIDS prevention
  - Sleep on back in empty crib for first year of life, room sharing ↓ risk of SIDS, bed sharing and tobacco exposure ↑ risk of SIDS

- Bathing
  - Room temperature water ± unscented soap, **never leave baby alone**, remove jewelry, no cotton swabs in ears, wash genital area with water
- Car seat
  - Rear-facing infant car seat or convertible infant/child car seat

ABNORMAL WEIGHT IN THE NEWBORN

MCC OBJECTIVE

Based on Objective #118-3 (Intrauterine Growth Restriction) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Low Birth Weight is the most important risk factor for infant mortality and is a significant determinant of infant and childhood morbidity.
- There is a high potential for long-term morbidity for both Intrauterine Growth Restriction (IGUR) and Large for Gestational Age (LGA) newborns (Table 18.3).

TABLE 18.3 • Complications of abnormal weight

Small for Gestational Age (SGA)	Large for Gestational Age (LGA)
1. Difficult cardiopulmonary transition: beware perinatal asphyxia, meconium aspiration, or PPHN	1. ↑ Risk cesarean delivery, severe postpartum hemorrhage, and vaginal lacerations
2. Complications of prematurity (e.g., respiratory distress syndrome (RDS), retinopathy of prematurity (ROP), intraventricular hemorrhage (IVH))	2. Birth injury: brachial plexus injury ± shoulder dystocia, clavicular fractures
3. Impaired thermoregulation	3. Respiratory distress: RDS (if born to diabetic mother), TTN (if born by C/S), and meconium aspiration syndrome (2° to perinatal depression)
4. Hypoglycemia: Risk correlates with severity of growth restriction.	4. Perinatal asphyxia
5. Polycythemia: risk ↑ with severity of growth restriction (hypoxia → ↑ EPO)	5. Hypoglycemia (due to hyperinsulinemia)
6. Impaired immune function	6. Polycythemia: hyperinsulinemia → oxidative demands → fetal hypoxia → ↑ EPO
7. Perinatal mortality: ↑ as growth restriction becomes more severe; congenital malformations, perinatal asphyxia, transitional cardiopulmonary disorders	7. ↑ Perinatal mortality
	8. Minor congenital anomalies: talipes calcaneovalgus, hip subluxation
	9. May have propensity for adult obesity

- IUGR: fetus that has not reached its growth potential because of genetic or environmental factors, results in birth of SGA infant
  - LGA: infant with BW > 90th percentile for gestational age
  - SGA: infant with BW < 10th percentile for gestational age

APPLIED SCIENTIFIC CONCEPT

- Barker hypothesis: adverse stimuli or events occurring *in utero* and during infancy can permanently change the body's structure, physiology, and metabolism, which can influence the occurrence of many diseases that will develop in adulthood.

CAUSAL CONDITIONS

SGA (Includes IUGR)

Maternal Factors

- Malnutrition
- Chronic hypoxemia (e.g., cyanotic cardiac or pulmonary disease, severe anemia)
- Medical conditions (e.g., renal disease, hypertension, sickle cell disease, chronic illness)

CLINICAL box

Infant Growth Facts

- Up to 10% of birth weight (BW) may be lost in first week of life.
- Should return to BW by 10 d of life
- Weight gain: 180 g/wk until 4 to 5 mo
- 2× BW by 4 to 5 mo
- 3× BW by 1 yr
- 4× BW by 2 yr

SIGNS OF UMBILICAL CORD INFECTION (OMPHALITIS)

- Fever
- Purulent discharge
- Redness and swelling
- Foul odor
- Bleeding (more than a few drops)

Remember: back to sleep, front to play

- Obstetrical complications (e.g., preeclampsia) associated with vasculopathy
- Viruses and parasites (e.g., TORCH)
- Drugs and toxins (e.g., cocaine, alcohol, cigarettes, anticonvulsants, antimetabolites)
- Demographic variables: First Nations, pregnancy at the extremes of reproductive life, young maternal age at first childbirth, nulliparity or grand multiparity, and previous delivery of SGA newborn

Placental Factors (Insufficiency)

- Abnormal uteroplacental vasculature/infarction
- Villous placentitis (e.g., bacterial, viral, parasitic)
- Placental abruption
- Structural anomalies (e.g., single umbilical artery, velamentous umbilical cord insertion, tumors)
- Rare: twin-to-twin transfusion syndrome

Fetal Factors

- Chromosomal disorders (e.g., trisomies, aneuploidy)
- Genetic syndromes (e.g., dwarfism)
- Major congenital anomalies
- Chronic infection (e.g., CMV, congenital rubella, syphilis)
- Multiple gestation

lGA

Maternal

- Familial
- Poorly controlled diabetes: excessive delivery of nutrients to the fetus, resulting in fetal hyperglycemia → hyperinsulinemia = ↑ growth, particularly of insulin-sensitive tissues
- Maternal obesity or excessive weight gain during pregnancy (normal is 25–35 lb)
- Multiparity: occurs more often as parity ↑
- Previous delivery of LGA infant
- Race and ethnicity: Hispanic and white newborns larger than black infants

Fetal

- Genetic syndromes (e.g., Beckwith-Wiedemann syndrome, Sotos syndrome)
- Postterm gestation
- Male fetus
- Rare: twin-to-twin transfusion syndrome

CLINICAL box

Calculating Fundal Height

Fundal height in centimeter = Weeks of gestation ± 2 (this rule only applies after 12 wk gestation)

AppROACh

history

Prenatal

- Maternal: social demographics, drug/teratogen exposure, PMHx, chronic illnesses, obstetrical Hx (previous and current: gestational hypertension, preeclampsia/HELLP, GDM, preterm bleeding, etc.), FHx of genetic abnormalities or early neonatal demise
- Fetal: single or multiple gestation, results of prenatal screening (GBS status, etc.), fundal height measurements

Delivery/Postnatal

- Gestational age at delivery, method of delivery (spontaneous vs. induced, C/S vs. vaginal, emergent vs. planned), rupture of membranes (length of time), use of instrumentation (forceps, vacuum), complications during delivery (maternal fever, hypoxia, birth trauma), Apgar scores, postdelivery course (how many days with mom vs. in nursery, time of discharge from hospital, complications after birth)

CLINICAL box

Classification of iuGR

Symmetric: symmetric reduction in anthropometric measurements, usually due to early gestational insult (e.g., congenital infections, chromosomal abnormalities)

Asymmetric: ↓ body weight with relatively normal length and head growth, usually due to gestational insult affecting growth in late 2nd/3rd trimester

physical Exam

- Weight, length, head circumference in relation to gestational age on growth chart
- Gestational age assessment (Ballard scoring system is accurate to within ± 2 wk)
- Vital signs, respiratory stability, levels of alertness
- Assess for dysmorphic features and/or anatomic defects (see Table 18.2)
- SGA infants with IUGR: symmetric or asymmetric (see Clinical Box, Classification of IUGR)
- LGA infants: assess for birth-related trauma and congenital anomalies; assess for possible hypoglycemia (e.g., jitteriness, lethargy, apnea)

Investigations

Prenatal

- Single best test to screen for and diagnose SGA/IUGR = prenatal U/S estimation of fetal weight, which also assesses biometrics (e.g., biparietal diameter, femur length) and amniotic fluid volume
- Fetal karyotyping: indicated if IUGR early (< 32 wk), severe (< 3rd percentile), or accompanied by polyhydramnios or structural anomalies
- Assessment for maternal thrombophilic disorders may be considered if IUGR recurrent, early, severe, or with positive FHx of thrombophilia.

Postnatal

- CBC
- Blood gases (Perinatal hypoxia leads to acidosis.)
- Blood glucose (hypoglycemia)
- Chemistry (hyperbilirubinemia, hypocalcemia)
- Blood/urine/CSF cultures as indicated
- Drug screen
- Genetics: karyotype, metabolic testing if suspicious
- Specific testing as indicated by careful Hx and physical exam

CLINICAL box

Ballard Score (Gestational Age Assessment)

1. Extent that sole of foot covered in creases
2. Presence and size of breast buds
3. Features of scalp hair
4. Formation of ear cartilage (pinna recoil)
5. Appearance of genitalia
6. Neurologic assessment of posture, active and passive tone, and reflexes

Diagnosis

- Based on weight at birth, but can often be anticipated by serial prenatal U/S estimation of weight and by understanding causal conditions (described above)

CLINICAL box

Use of Doppler Studies In Utero

Doppler studies of the umbilical artery are not useful for screening and Dx of IUGR. Instead, they are used to identify the small fetus at risk for adverse perinatal outcomes (preterm birth, NICU admission, asphyxia, etc.).

Management

Small for Gestational age/Intrauterine Growth Restriction

- Anticipate complications: delivery should be planned at a secondary or tertiary center with an NICU.
- Prompt resuscitation; avoid heat loss by immediate drying and placement under a radiant warmer
- Appropriate therapy for disorders of transition, including meconium aspiration syndrome, myocardial dysfunction, or persistent pulmonary hypertension
- Enteral feeding (often by NG if preterm—suck reflux not yet developed) can be started early in healthy infants; for those unable to tolerate enteral feeds (e.g., severely ill), provide parenteral feeds.
- Serial monitoring for hypoglycemia and ionized calcium levels; supplement appropriately
- Postnatal assessment for congenital malformations, characteristics of chromosomal abnormalities, or signs of congenital infection

Large for Gestational age

- If no contraindications, such as perinatal depression or other illness, feed early to avoid hypoglycemia and monitor glucose levels regularly after birth; measure hematocrit to detect polycythemia
- Low threshold for initiation of respiratory support

NEONATAL JAUNDICE

MCC OBJECTIVE

Based on Objective #49-1 (Neonatal Jaundice) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Jaundice is common in the neonatal period, affecting up to 80% of newborn infants. It is important to distinguish between conjugated (direct) and unconjugated (indirect) hyperbilirubinemia, to help determine the underlying etiology and appropriate treatment.

!

Conjugated hyperbilirubinemia (when > 20% of the total bilirubin is conjugated) is always pathologic and must be investigated further.

APPLIED SCIENTIFIC CONCEPT

Bilirubin is produced by the catabolism of hemoglobin. The initial breakdown product of hemoglobin is unconjugated bilirubin, which is not water soluble, and therefore must be made into a soluble product before it can be excreted. It is transported to the liver where the enzyme UDP-GT facilitates the conjugation of bilirubin. Conjugated bilirubin is water soluble, and is further broken down into urobilinogen and stercobilinogen, which are excreted in the stool and, to a lesser degree, in the urine.

CAUSAL CONDITIONS

Unconjugated Hyperbilirubinemia

Increased Production
- Extravascular blood (cephalohematoma)
- Polycythemia (delayed cord clamping, twin-to-twin transfusion)
- Red cell instability (G6PD, spherocytosis, elliptocytosis, decreased RBC half-life)
- Coombs positive: isoimmunization (Rh, ABO, minor antigens)

Decreased Conjugation (UDP-GT Deficiency)
- Prematurity
- Gilbert syndrome
- Crigler-Najjar syndrome
- Congenital hypothyroidism

Increased Reuptake (via Enterohepatic Circulation)
- Breast-feeding jaundice (secondary to dehydration)
- Bowel obstruction (meconium ileus, etc.)

Conjugated Hyperbilirubinemia

Sepsis

Intrauterine Infection (TORCH)
- **T**oxoplasmosis
- **O**ther: syphilis, EBV
- **R**ubella
- **C**ytomegalovirus
- **H**erpes, HIV

Hepatic
- Biliary atresia
- Alagille syndrome
- Disorders of bile acid metabolism
- Neonatal hepatitis
- Choledochal cyst
- Underlying metabolic condition (Galactosemia, tyrosinemia)
- Infiltrative (Wilsons, α_1-antitrypsin deficiency)
- TPN-related cholestasis
- Cystic fibrosis

APPROACH (Figure 18.1)

History

- Exact time and date of birth (to calculate the newborn's age in hours)
- Onset, duration, progression, rate of change
- Pregnancy and delivery Hx: maternal illness (Hx of GBS UTI), blood type (maternal and newborn, if known), prenatal serologies, substance use during pregnancy, prolonged rupture of membranes, presence of maternal fever during delivery, if antibiotics were given during delivery (what type and how many doses), traumatic birth (presence of extravascular blood), delayed cord clamping, Apgar scores, gestational age, BW, bilirubin at time of discharge from hospital
- Postnatal Hx: breast-feeding versus formula feeding, frequency and length of feeds, presence of adequate milk supply if breast-feeding exclusively, number of wet diapers, pale stools or dark urine, waking to feed, medications/supplements, current weight (percentage weight loss from birth)
- FHx: pedigree, jaundice (scleral icterus), hematologic or metabolic disorders, anemia, liver disease, autoimmune conditions, ethnicity, early neonatal deaths, consanguinity

Physical Exam

- Vital signs: fever, tachycardia, level of consciousness
- Growth parameters: weight change from BW
- General inspection: cephalocaudal progression of jaundice, presence of hematomas

CLINICAL box

Kernicterus

Kernicterus is the neurologic outcome of bilirubin deposition in the basal ganglia and brainstem nuclei. It is a result of elevated unconjugated hyperbilirubinemia.

- Early signs: lethargy, poor suck, hypotonia, high-pitched cry, seizures
- Late signs: irritability, hypertonia, opisthotonos, fever

CLINICAL box

Risk Factors for Severe Hyperbilirubinemia

- Jaundice within the first 24 h of life
- Blood group incompatibility (DAT positive)
- Late preterm infants (35–36 + 6 wk gestational age)
- Cephalohematoma
- Sibling requiring phototherapy
- Exclusively breast-feeding
- East Asian race
- G6PD deficiency

CLINICAL box

Risk factors for Neonatal Sepsis

- Rupture of membranes for > 18 h before delivery
- Maternal fever (T > 38°C) during labor
- Chorioamnionitis
- Maternal GBS colonization (i.e., GBS UTI)
- Prior delivery of an infant with GBS disease

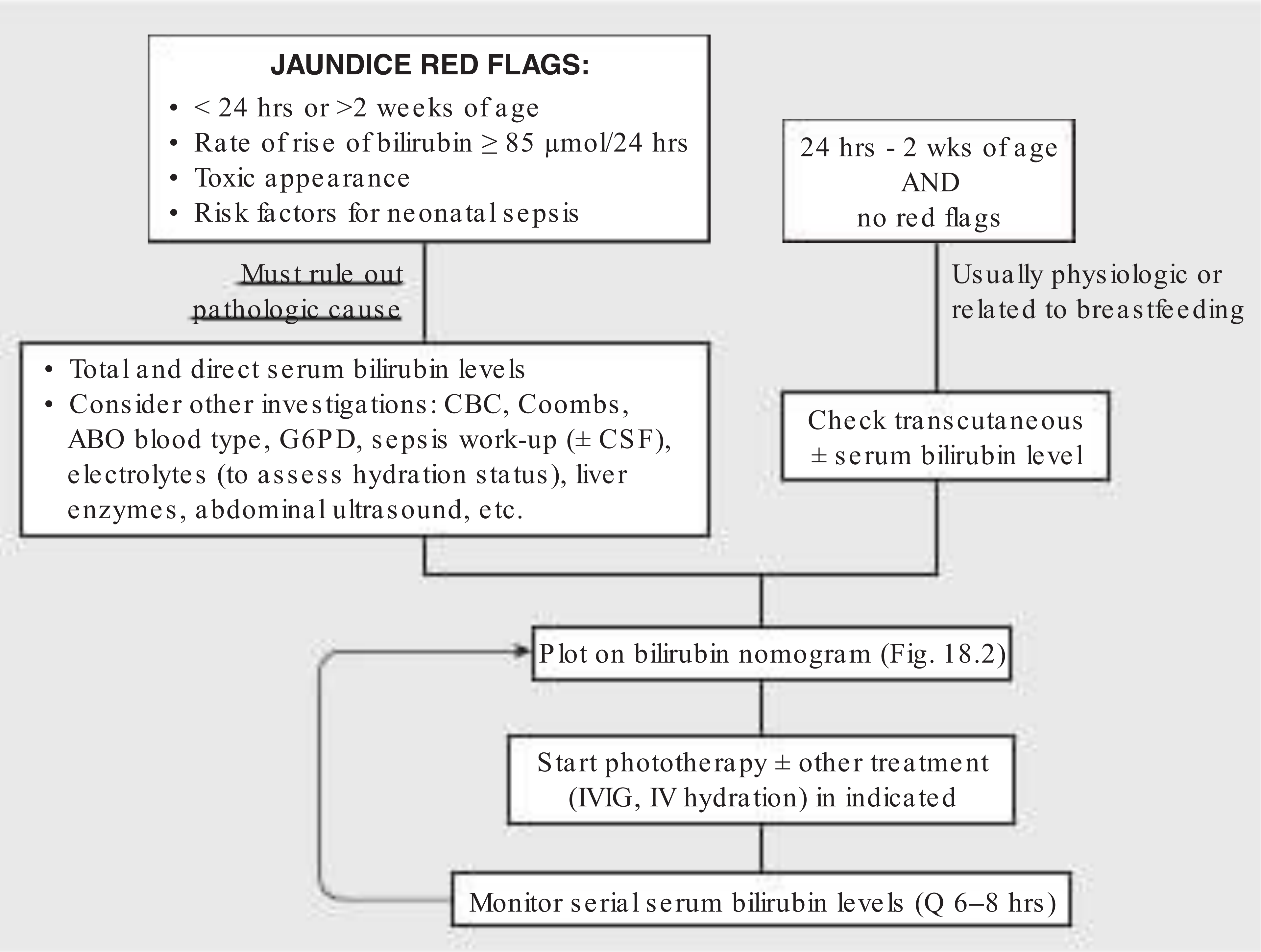
JAUNDICE RED FLAGS:
• < 24 hrs or >2 weeks of age
• Rate of rise of bilirubin ≥ 85 µmol/24 hrs
• Toxic appearance
• Risk factors for neonatal sepsis
24 hrs - 2 wks of age AND no red flags
Must rule out pathologic cause
Usually physiologic or related to breastfeeding
• Total and direct serum bilirubin levels
• Consider other investigations: CBC, Coombs, ABO blood type, G6PD, sepsis work-up (± CSF), electrolytes (to assess hydration status), liver enzymes, abdominal ultrasound, etc.
Check transcutaneous ± serum bilirubin level
Plot on bilirubin nomogram (Fig. 18.2)
Start phototherapy ± other treatment (IVIG, IV hydration) in indicated
Monitor serial serum bilirubin levels (Q 6–8 hrs)

Figure 18.1. Approach to neonatal jaundice.

- Head: bulging versus sunken fontanelle, alert versus lethargic, scleral icterus
- Hydration status: mucous membranes, femoral pulses, capillary refill time
- Abdo: hepatosplenomegaly, ascites, dark urine, pale stools
- Skin: purpura, petechiae, rashes
- Neurologic: response to exam, hyper or hypotonic, irrepressible movements (seizures), primitive reflexes

CLINICAL box

ABO Isoimmunization

ABO incompatibility (the mother is blood type O, and the baby is blood type A or B) is an important cause of hemolytic disease of the newborn that must be ruled out. If a newborn has rapidly increasing bilirubin levels approaching levels for exchange transfusion, IVIG should be considered.

Investigations

Routine Investigations

- CBC
- Blood smear
- Total and direct bilirubin (absolute values and rate of rise)
- ABO blood type
- Coombs test
- Electrolytes

Specialized Tests

- G6PD
- Sickle cell screen
- Hemoglobinopathy screen
- Reticulocyte count
- Sepsis workup (urine culture, blood culture ± CSF culture)
- Metabolic evaluation (galactosemia screen, TSH, free T_4)
- Abdo U/S
- Hepatobiliary iminodiacetic acid (HIDA) scan

Diagnosis

- To determine if treatment is necessary for unconjugated hyperbilirubinemia, the neonatal serum bilirubin nomogram is used (Figure 18.2).
- Infants are placed in the low-, intermediate-, or high-risk zone depending on their risk factors and gestational age; treatment varies depending on risk zone.
- If greater than 20% of the total bilirubin is conjugated, then further workup should be completed to evaluate for a pathologic cause (see Specialized Tests, above).

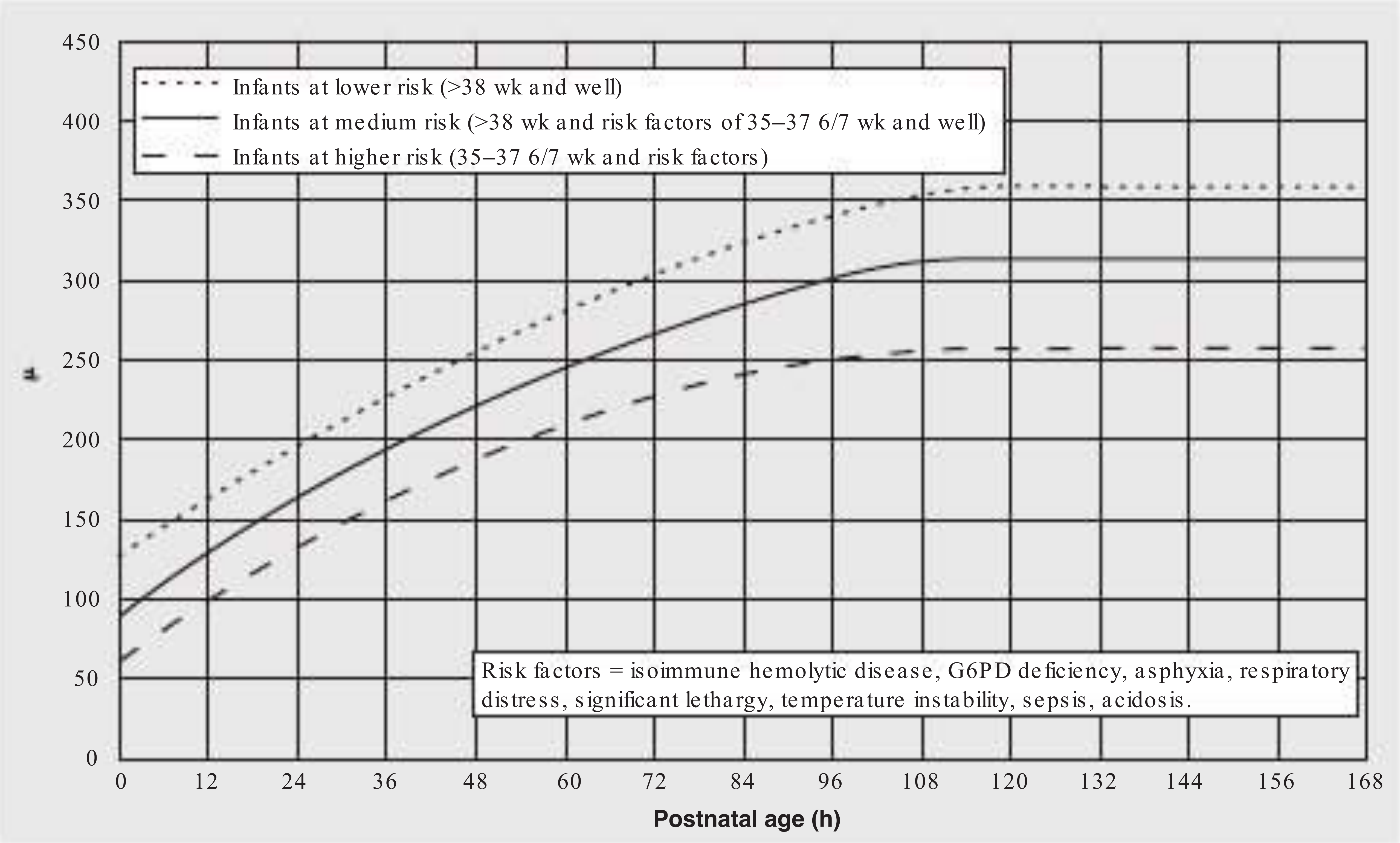

Figure 18.2. Neonatal serum bilirubin nomogram.

Management

See Table 18.4 for the treatment of unconjugated hyperbilirubinemia. The management of conjugated hyperbilirubinemia is dependent on the underlying etiology (see Causal Conditions, above). Many of the etiologies of conjugated hyperbilirubinemia have serious morbidity and mortality; therefore, they must be investigated further and treated promptly.

TABLE 18.4 • Treatment of unconjugated hyperbilirubinemia

treatment	Principle	Advantages	Disadvantages
Phototherapy	Photoisomerization of unconjugated bilirubin to water soluble isomers	• Relatively safe for mild to moderate hyperbilirubinemia	• Contraindicated in conjugated hyperbilirubinemia (“bronze baby”) • Potential for burns, retinal damage • Separation of the infant and parents
Pharmacologic	IVIG (for isoimmune hemolytic disease), heme-oxygenase inhibitors (metalloporphyrins)	• May reduce need for exchange transfusion	• Unclear efficacy, long-term effects • May have sedative effects
Exchange blood transfusion	Reserved for dangerously high levels or patients exhibiting symptoms of kernicterus. Removes and replaces partially hemolyzed and antibody-coated erythrocytes	• Most rapid method of treatment	• NEC • Metabolic acidosis • Thrombocytopenia • Coagulopathy • Arrhythmias • Infection • Death

CHILDHOOD IMMUNIZATIONS

MCC OBJECTIVE

Based on Objective #74-2 (Infant and Child Immunization) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Immunization is an important part of preventative medicine for children. Physicians should be knowledgeable about the benefits and risks associated with immunization in order to counsel families.

Vaccines are classified into 3 types:

- Live attenuated: contain whole/weakened bacteria/virus. Usually produce immunity with 1 dose.
- Whole inactivated: contain whole- or part-killed bacteria/virus. Does not cause disease it is designed to prevent. Usually require more than 1 dose.
- Subunit: organism parts, protein/toxoid, polysaccharide ± conjugate

APPLIED SCIENTIFIC CONCEPT (Table 18.5)

- Active immunization: complex biologic products designed to induce protective immune response

TABLE 18.5 • Live attenuated vaccines and inactive vaccines

Live Attenuated	
Bacterial	• BCG • Typhoid (oral)
Viral	• Influenza (intranasal) • MMR • Rotavirus • Varicella • Yellow fever
Inactivated	
Whole	• Viruses (polio, hepatitis A, rabies) • Bacterial (cholera)
Fractional	• Protein-based 1. Toxoid (diphtheria, tetanus) 2. Subunit (hepatitis B, acellular pertussis) 3. Split-virus (some influenza) • Polysaccharide-based 1. Pure (pneumococcal polysaccharide, parenteral typhoid) 2. Conjugate (pneumococcal conjugate, HiB, meningococcal) • Virus-like particle (HPV)

- Passive immunization: prevent infection and reduce severity of illness. Used when vaccines for active immunization not available ± contraindicated, unimmunized people exposed to agent, or in immunocompromised individuals.

Vaccines work on 2 levels:

- Individual level: protect immunized person from getting the disease
- Population level: reduce incidence and exposure to illness, in particular to vulnerable populations (newborns, the elderly)—“herd immunity”

Additives within vaccines:

- Adjuvant (aluminum salt) to enhance immune response
- Preservatives (thimerosal) to prevent serious secondary infections
- Other additives (egg, animal protein, glycerol, formaldehyde) support stability and growth of antigens.

AppROACh

history

- ID: age, gender, country of birth
- CC/HPI: thoughts and concerns around immunizations
- Inquire about previous anaphylactic reactions to immunization (urticaria, angioedema, shortness of breath or respiratory distress, shock)
- PMHx: overall health, immunodeficiency, chronic illnesses, functional hyposplenia (sickle cell disease, thalassemia major, celiac disease, IBD), HIV, GBS, seizures, bleeding with previous vaccinations. If young infants, inquire about whether they are ambulatory or not (nonambulatory: can give vaccines in upper leg; ambulatory: give vaccines in upper arm)
- PSHx: splenectomy, organ transplant, hematopoietic cell transplant, excessive bleeding with prior surgeries
- Birth Hx: maternal anti-HBsAg, IVIG/vaccinations at birth, prematurity
- Medications: immunosuppressive medications (e.g., chemotherapy, cyclosporine, azathioprine, tacrolimus), steroids, IVIG Tx
- Allergies: drugs, food (eggs, latex, gelatin, antibiotics)
- Immunizations: UTD? Including seasonal shots (influenza), last immunizations, adverse reaction/anaphylaxis to immunization, missed doses
- Family Hx: Hx of functional asplenic conditions, bleeding disorders

physical Exam

- Vitals, anthropometrics (plot on WHO growth chart)
- HEENT: scleral icterus, signs of allergic rhinitis
- Respiratory: wheeze, crackles
- CVS: murmurs, extra heart sounds, peripheral edema
- Abdo: splenomegaly, surgical scars (prior splenectomy)
- MSK: joint effusions
- Skin: petechiae or purpura, eczema, urticaria

Counseling

Informed consent obtained by parents after exploring the following:

- Benefits of immunization
  - Prevents serious childhood infections that may result in severe illness or death (meningitis, epiglottitis, whooping cough, tetanus)
  - Decreases chance of transmission and infection in those who are unable to be immunized (herd immunity)
  - Mass immunization may lead to eradication of vaccine-preventable diseases (small pox).
- Potential side effects of vaccination (Table 18.6)

TABLE 18.6 • Possible side effects of vaccination

- Common: fever, tenderness/swelling at injection site, tiredness, poor appetite, emesis
- MMR/VZV: “pseudo-infection” (measles-like rash, parotitis, lymphadenopathy, arthralgia/arthritis, mild varicella-like papules/vesicles), 1/40,000 thrombocytopenia, 1/25,000 febrile seizure
- DTaP: 1/14,000 seizure, 1/1,000 prolonged crying (> 3 h)
- Occasionally more serious reactions (anaphylaxis/allergy)

- Breaking Common Myths
  - Vaccines (MMR) **do not** cause autism, autism spectrum disorder, or IBD.
  - Mercury in vaccines **does not** cause brain damage, autism, attention-deficit disorder, or learning disorders.

  - Thimerosal has **not** been used in routine infant vaccines since 2001.
  - Vaccinations **do not** cause SIDS.
- Missed immunizations
  - No need to restart if one is missed—pick up where it was left off
  - Inadequate records: restart primary immunization protocol based on age
- Alternatives of not vaccinating: important to acknowledge and respect parental concerns—provide with current information and allow them to make final decision
  - Bring up vaccinations at each visit
  - Ensure parents are educated about the greater risk of getting vaccine-preventable illnesses (Stopping immunization has led to disease outbreaks with significant morbidity and mortality.)

CLINICAL box

Additional References for parents

Can direct parents to obtain more information about vaccinations on the Caring for Kids website: http://www.caringforkids.cps.ca/handouts/immunization-index.

Management

- Vaccination schedules vary from province to province.
- Vaccine recommendations to parents should include the routine vaccination schedule based on NACI recommendation (Table 18.7).

TABLE 18.7 • Basic vaccination schedule

Age	Recommended Vaccination
2 mo	DTaP-IPV-HiB Rotavirus Men-C Pneum-C-13
4 mo	DTaP-IPV-HiB Rotavirus Men-C Pneum-C-13
6 mo	DTaP-IPV-HiB Rotavirus Men-C Pneum-C-13
6–59 mo	Influenza (seasonal)
12 mo	MMR Varicella Men-C Pneum-C-13
18 mo	DTaP-IPV-HiB MMR Varicella
4–6 yr	DTap-IPV MMR Varicella
Preteen	Men-C-A, C, Y, W-135 Hepatitis B HPV
14–16 yr	Tdap or Tdap-IPV

- Specific populations:
  - Asplenia/hyposplenic (congenital, surgical, functional)—no contraindications to vaccines, should receive influenza annually, need coverage for encapsulated organisms (Hib, *N. meningitidis*, *S. pneumoniae*)
  - Travelers—consider rabies, typhoid fever, yellow fever, hepatitis A, cholera. Direct patients to travel clinic for more information.
  - BCG vaccine—infants of parents with infectious TB at delivery, high-risk populations (First Nations)

  - RSV immune globulin—indicated for children under 24 mo with prematurity (born at < 32 wk gestational age), chronic lung disease, heart disease, or living in a rural or remote location
  - Premature infants—the timing of immunization is based on chronological age, not gestational age.
- Contraindications to vaccination
  - Previous anaphylactic reaction to vaccine or component (live or inactivated vaccines)
    - Components = gelatin (MMR), egg (influenza), yeast (hepatitis B), streptomycin (DTaP)
  - Live vaccines—severe asthma or wheezing requiring medical attention in last week, pregnancy, severe immunodeficiency or active immunosuppressive therapy, TB (MMR, MMRV, univalent varicella, herpes zoster, BCG)
  - Rotavirus—congenital malformation of GI tract or intussusception
  - Influenza vaccine—do not give vaccine to patients who have had ocluo-respiratory syndrome after prior influenza vaccine
- Relative contraindications
  - Guillain-Barré syndrome within 6 wk of vaccination
  - Moderate/severe illness
  - Rotavirus—moderate-severe gastroenteritis

Special Precautions

- Moderate to severe illnesses
- Bleeding disorders
- Blood products containing antibodies can interfere with the endogenous antibody response to a live vaccine. Therefore, if a patient has received an antibody-containing vaccine, administration of live vaccines should be delayed 3 to 6 mo

INCONSOLABLE CRYING (CRYING OR FUSSING CHILD)

MCC OBJECTIVE

Based on Objective #71-1 (Crying or Fussing Child) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- A young child or infant whose only symptom is crying poses a unique challenge to the physician to distinguish between benign and organic causes.
- Inconsolable crying in a young child or infant imposes stress on both caregiver and physician.
- The physician must differentiate between conditions that require emergency treatment versus those that do not.

APPLIED SCIENTIFIC CONCEPT

- Infants communicate and express discomfort by crying. The reasons are numerous—from hunger to desire to life-threatening illnesses.
- Normal crying patterns: on average 3 h/d by 6 wk of age
- Peak crying time—15:00 to 23:00
- Organic disease underlies < 5% of cases of infantile colic
- Etiology of colic remains unknown
  - Possible causes: GI dysfunction—cow's milk protein allergy, malabsorption, GI dysmotility, headaches

CAUSAL CONDITIONS (Table 18.8)

Special Consideration: Infantile Colic

- Benign, self-limited condition (see Clinical Box, Rome Criteria for Infantile Colic)
- It is a Dx of exclusion.
- Begins in the first weeks of life, and peaks during the 2nd to 3rd month
- First few weeks of life are unremarkable, and infant is normal when not "colicky."
- Seen equally in both sexes, across cultures, and breast-fed and bottle-fed infants.

TABLE 18.8 • DDx of prolonged crying by system

System	Possible etiology
General	Drug ingestion/overdose Hunger, colic, discomfort
Skin	Tourniquet (digit or penis) Pinching of skin—diaper pin Atopic dermatitis Burns (accidental/nonaccidental) Bite/stings
Eyes	Foreign body Glaucoma Corneal abrasion
ENT	Otitis media Nasal congestion Thrush
Cardiovascular	Heart failure Supraventricular tachycardia Myocarditis
Chest	Hypoxia Hypercarbia Pneumonia Bronchiolitis Acute airway obstruction (croup/foreign body, asthma)
GI	Diarrhea/constipation Intussusception Anal fissure Inguinal hernia Volvulus/malrotation Gastroesophageal reflux Peritonitis Intestinal obstruction
Genitourinary	Urinary tract infection Urinary tract obstruction Torsion of testes or ovaries Nephrolithiasis
Skeletal	Trauma-fracture Osteomyelitis Subluxation/dislocation Nonaccidental injury
CNS	Meningitis/encephalitis Abusive head injury Epilepsy Degenerative condition
Toxic-metabolic	Ingestion Electrolyte abnormality Inborn error of metabolism Hyperthyroidism

CLINICAL box

Rome Criteria for Infantile Colic

Occurs in infants < 4 mo of age with the following:

1. Paroxysmal without obvious cause
2. No effect on infant's growth and development (no failure to thrive)
3. Lasts for > 3 hr/d, > 3 d/wk (for > 1 wk)

APPROACH

History

- Detailed crying Hx (see Clinical Box, Crying Hx)
  - Length of time, timing of crying, progression/worsening, pattern of crying, alleviating/precipitating factors, any other symptoms associated with crying (fever, vomiting, increased sleepiness, drawing up legs to abdo, difficulty breathing), any trauma, lumps or bumps noticed (hernia)

- Pregnancy/birth Hx: prenatal care, problems during pregnancy, alcohol/drug use, GBS status (bacterial meningitis), gestational age, type of delivery, complications after birth, BW
- Nutrition/development: feeding (breast or bottle), how frequent, cyanosis with feeds, diaphoresis with feeds (cardiac condition)
- Stooling: frequency, appearance of stool, blood in stool, crying associated with stooling or around stooling
- Voiding: number of diapers per day (hydration status), foul smell, or color change of urine (UTI)
- Sleeping patterns: hours per day, wakes to feed, seems content, has alert periods through the day
- General development: no regression in milestones achieved
- PMHx/medication: any medical conditions, visits to emergency room, medications (including herbal medications, supplements), allergies, immunization status
- FHx: draw pedigree
- SHx: extremely important to assess coping of parents to rule out abuse or abusive head trauma as an etiology for crying
    - Maternal age, paternal age, involvement in care of child
    - Living situation
    - Support system for parents (family/other)
    - Financial situation
    - Parents' sleep (hours of sleep, feeling tired)
    - Parents' mood (crying, feelings toward child—screen for depression)
    - Other concerns from parents/mom

CLINICAL box

Crying Hx

- When does the crying occur, and how long does it last?
- What do you do when the baby cries?
- How does it make you feel when your baby cries?
- How has the colic affected your family?
- Why do you think the baby cries?

physical Exam

- Vital signs: tachycardia, fever
- General: does the child appear sick unwell or well? Disposition—lethargic, paroxysmal irritability (meningitis/encephalitis)
- Anthropometrics: plot growth parameters on WHO growth curve
- HEENT:
    - Skull: swelling, tenderness, skull depression (trauma)
    - Fontanelle: sunken (hydration status), bulging/full (meningitis/intracranial process), large fontanelle (hydrocephalus), closed (craniosynostosis)
    - Ears: discharge, erythematous tympanic membrane, loss of landmarks, effusion, bulging (otitis media), contusion to external ear (nonaccidental injury)
    - Eyes: sunken (hydration status), red reflex (absent—tumor, retinal detachment), pupillary size/reflex, corneal enlargement (glaucoma), discharge or tearing (infection, allergy, glaucoma)
    - Oropharynx: thrush, vesicular lesions
- Cardiac: central and peripheral pulses (bounding vs. weak), capillary refill time, heart sounds ($S_1 + S_2$, muffled sounds, additional sounds, murmurs)
- Respiratory: increased work of breathing—tachypnea (bronchiolitis, pneumonia, foreign body), bradypnea (head trauma, ingestion), auscultation—wheezing (asthma, bronchiolitis), air entry (pneumonia)
- Abdo: distention/masses—sausage shape abdo mass (intussusception), bowel sounds
- GU: rashes in diaper/genital area, anal fissures, bulging in groin/umbilicus (incarcerated or strangulated hernia), hair tourniquet, if male: retracted foreskin, cremasteric reflex (torsion)
- Skin/MSK: rashes, bruising, painful extremities on palpation/deformation of extremities, swollen/red joints (osteomyelitis)

CLINICAL box

Emergencies to Rule Out

1. Hair tourniquet: remove tourniquet immediately and ensure blood flow returns to area
2. Testicular torsion: U/S doppler, referral to urologist immediately, transfer to center where pediatric urologist available if high index of suspicion
3. Glaucoma: referral to an ophthalmologist
4. Malrotation/volvulus: Abdo plain films, general surgery consultation
5. Intussusception: Abdo U/S, air enema, surgical consultation
6. Incarcerated/strangulated hernia: Dx based on exam, inability to reduce hernia, consider U/S, general surgery consultation
7. Septic arthritis: consider joint aspiration if clinical exam suspicious, start antibiotics early
8. Abusive head trauma: head imaging, skeletal survey, involve child services and team that deals with suspected cases of abuse

Investigations

Routine investigations are not warranted for crying infants, unless guided by specific indicators on Hx or physical exam. Investigations may include:

- CBC: leukocytosis, signs of infection
- Electrolytes, glucose: metabolic disturbance
- Urinalysis: UTI, RTA
- ECG: CHF or ALCAPA
- CXR: if considering intrathoracic pathology
- Other investigations include: urine ± blood cultures, toxicology screen if considering ingestion, abdo plain films or U/S, skeletal survey

- See the Child Abuse section of this chapter for further information about nonaccidental trauma

Management

Counsel caregivers of fussy/crying children without organic disease. Select children who require follow-up for additional investigations or referral to specialist.

Management of Colic

- Parental support/education: acknowledgment of frustrations, education, encouraging taking breaks from crying infant. Offer to provide social resources or closer follow-up if concerned about parental well-being

Dietary Changes

- Breast-fed infants: hypoallergenic diet in mother (milk, egg, wheat, nut, fish, soy free) may reduce colic in some infants, although conflicting evidence.
- Formula-fed infants: hypoallergenic formula (hydrolyzed casein/whey protein and amino acid based) may be effective in reducing colic in formula-fed infants. Soy-based formula may reduce symptoms of colic in some infants; however, this is not recommended because of common allergen in infancy.

Supplements and Medications

- Probiotics and prebiotics: insufficient evidence for or against use in the treatment of colic. May show some improvement in breast-fed infants. More studies needed—no adverse effects identified.
- Simethicone has not been shown to have benefit.

Alternative Therapies

- Manipulative therapies: gentle manipulative techniques used in osteopathy and chiropractic therapies—not safely established. Cannot draw conclusions regarding these techniques.
- Acupuncture: conflicting results. Not recommended as treatment.
- Swaddling: current evidence base does not support use of swaddling for management of infantile colic.

FEVER WITHOUT A SOURCE

MCC OBJECTIVE

Based on Objective # 107-3 (Fever in a Neonate, Fever in a Child) of Objectives *for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Fever in a neonate (< 28 d old) is potentially indicative of a life-threatening infection and requires a full septic workup.
- Fever in children is the most common symptom for which parents seek medical advice. While most causes are self-limited viral infections, it is important to identify if there is an infection amenable to treatment or serious underlying condition.
- Definitive measurement technique: rectal (< age 5 yr); oral (> age 5 yr)
- Rectal temperature > 38°C is considered a fever (Table 18.9).

TABLE 18.9 • Normal temperature ranges

Rectal	36.6°C–38°C
Tympanic	35.8°C –38°C
Oral	35.5°C–37.5°C
Axillary	34.7°C–37.3°C

- Acute fever (< 2 wk in duration) is commonly due to infectious causes, while inflammatory or malignant etiologies should be considered in subacute or chronic fevers (> 2 wk in duration). However, all three etiologies should always be on the differential for a child with fever.

CLINICAL box

Pyrogens

A pyrogen is a substance the produces fever—that is, a portion of viruses or bacteria (lipopolysaccharide) or components of the innate and active immune system (complement, antigen–antibody complexes).

CLINICAL box

Reye Syndrome

- Aspirin should not be used to treat acute febrile illness in children.
- ASA ingestion by children with varicella or influenza has been associated with Reye syndrome.
- Reye syndrome is characterized by encephalopathy and fatty degeneration of the liver and is associated with significant morbidity and mortality.

Applied Scientific Concept

- Fever is an important physiologic response to invading pathogens.
- The thermoregulatory center is in the hypothalamus, and is responsible for maintaining the body's temperature within a specific range.
- The production of heat occurs by increased cellular metabolism, often by involuntary shivering of skeletal muscle.
- The specific range targeted by the thermoregulatory center in the CNS can be changed by the presence of cytokines and pyrogens (see Clinical Box, Pyrogens), resulting in activation of body mechanisms to create heat, and the production of fever
- Importantly, the increase in the set point of the thermoregulatory center is mediated by PGE_2—the target of antipyretic agents, such as NSAIDs and acetaminophen.

Mechanism of Antipyretic Agents

- Synthesis of PGE_2 depends on COX; therefore, antipyretics = COX inhibitors
  - Nonsteroidal anti-inflammatory agents (indomethacin, ibuprofen): COX inhibitors and excellent antipyretics
  - Acetaminophen: poor COX inhibitor in peripheral tissue but oxidized in CNS to a form that inhibits COX
  - Glucocorticoids reduce PGE_2 synthesis by inhibiting the activity of phospholipase A_2 (preventing release of arachidonic acid) and block the transcription of mRNA for pyrogenic cytokines.

Causal Conditions (Figure 18.3)

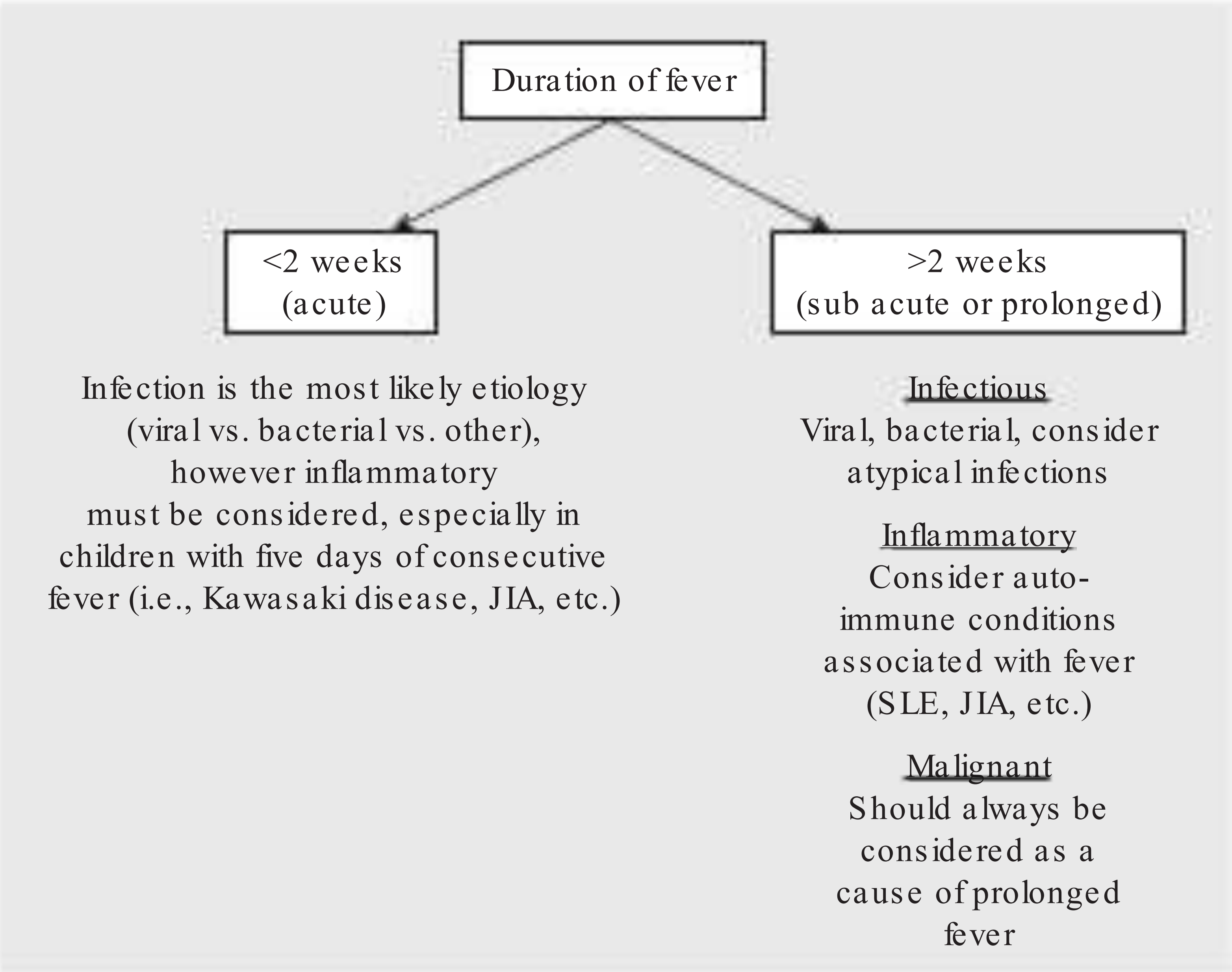
Duration of fever
<2 weeks (acute)
>2 weeks (sub acute or prolonged)
Infection is the most likely etiology (viral vs. bacterial vs. other), however inflammatory must be considered, especially in children with five days of consecutive fever (i.e., Kawasaki disease, JIA, etc.)
Infectious
Viral, bacterial, consider atypical infections
Inflammatory
Consider auto-immune conditions associated with fever (SLE, JIA, etc.)
Malignant
Should always be considered as a cause of prolonged fever

Figure 18.3. Cause of fever by duration.

Approach

History

- ID: age (if neonate or infant, exact number of days)
- Fever Hx: exact number of hours per days, clarify mechanism of measurement and how high the fever is, if fever is persistent or episodic, response to antipyretics (and which antipyretics used, dosage, frequency), previous fevers, precipitating factors (e.g., drugs), associated symptoms (e.g., salmon-pink rash—JIA)
- Review of systems: weight loss, night sweats, energy level, appetite, fluid intake (exactly how much and how often), rashes, swollen joints, focus of infection (cough, coryza, fluid from ears, etc.), dysuria (or anuria), abdo pain, emesis, change in bowel movements (diarrhea ± blood, mucous), abnormal vaginal/penile discharge, headache, behavior changes, gait changes, cough, shortness of breath

- PMHx: pregnancy Hx (if neonate or infant—GBS status, duration of rupture of membranes, prophylactic antibiotics, signs of chorioamnionitis, complications of pregnancy and delivery, postnatal course), feeding Hx if neonate/infant (is baby waking to feed vs. lethargic, voiding/stooling normal amounts), chronic illnesses, hospitalizations, surgeries, development, recent medications (antibiotics, glucocorticoids, immune suppressants), immunizations, allergies
- SHx: recent travel/camping/boating, exposure to family members with travel Hx, known TB contacts, if adolescent—always take HEADDSSS Hx
- FHx: recent travel or infections in family members, Hx of autoimmune conditions, or malignancy. FHx of immune deficiencies, early neonatal deaths, genetic conditions.

physical Exam

- Vitals: if fever present, note where it was taken (axillary, tympanic, oral, or rectal), BP (check against normal value charts for gender, age, and height), HR, RR (tachypnea can be a sensitive indicator for pneumonia, but may also be present with fever), oxygen saturation
- General appearance: toxic versus nontoxic, level of consciousness, color, level of distress
- HEENT: fontanelle (infant), lymphadenopathy, conjunctivitis (bilateral vs. unilateral, purulent vs. nonpurulent), rash (the rash of measles begins on the head and moves downwards), erythema or bulge behind tympanic membrane, ear displacement or any focal area of erythema (i.e., retroauricular), oropharynx (posterior oropharynx—erythema, exudate, tonsillar hypertrophy, palate—petechiae, buccal mucosal—Koplik spots), neck (nuchal rigidity, Kernig sign, Brudzinki sign; see Clinical Box, Clinical Signs of Meningitis)
- CVS: murmur, extra heart sounds, muffled heart sounds, perfusion
- Respiratory: work of breathing, asymmetric movement of chest, adventitious sounds (stridor, wheeze, crackles), decreased air entry, dullness to percussion
- Abdo: increased bowel sounds, distension, pain, masses, hepatosplenomegaly
- MSK: deformities, localized tenderness, erythematous/swollen joints or extremities (Kawasaki disease—edema of hands/feet), decreased ROM
- Skin: rash (viral exanthem, petechiae, maculopapular), lesions (check entire body, including oropharynx, palms of hands/feet), localized erythema

Investigations

Depending on your Hx and clinical exam, investigations may not be indicated (if the child appears well, you suspect viral infection, and the family has good follow-up for any further concerns).

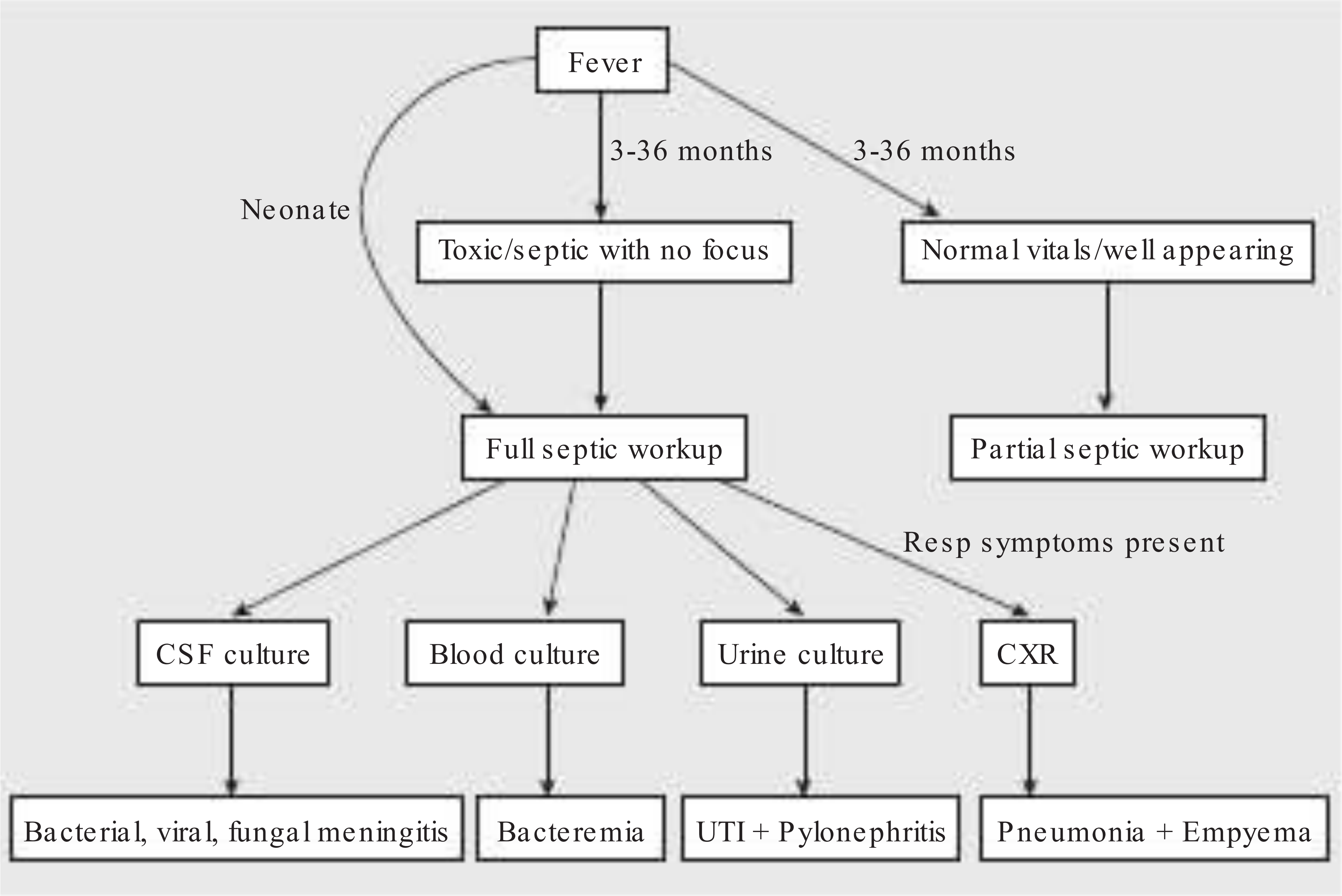

Figure 18.4. Approach to fever without a source.

CLINICAL box

Clinical Signs of Meningitis

- Nuchal rigidity
- Kernig sign—when upper leg flexed at 90 degrees, extension of leg is painful.
- Brudzinki's sign—forced flexion of head results in involuntary flexion of hips.

CLINICAL box

Kawasaki Disease Criteria

Fever for at least 5 d, and the presence of at least 4 of the 5 following signs:

- Bilateral, nonpurulent conjunctivitis
- Mouth/oropharyngeal changes—strawberry tongue, dry/cracked erythematous lips
- Polymorphous rash
- Extremity changes—edema of hands and feet, in later stages can see desquamation (peeling) of periungual skin
- Unilateral cervical adenopathy, > 1.5 cm

Investigations to consider include (Figure 18.4):

- Laboratory: CBC ± blood culture, electrolytes, liver enzymes, creatinine, urea, ESR, CRP
- Urine: urinalysis (usually a urine dip) ± culture, if indicated
- Stool: culture (bacterial), electron microscopy (viruses), O&P
- CSF: LP indicated in neonates with fever and the majority of infants < 90 d of age with fever. Consider in other children if toxic in appearance, altered level of consciousness, etc.
- Other: throat swab (bacterial pharyngitis), joint aspiration (if swollen, erythematous joint—in consultation with rheumatologist or orthopedics)
- Imaging: CXR (if respiratory symptoms or increased WOB), abdo XR (if signs of obstruction or concerned for pneumoperitoneum), joint or bone XR (if suspect osteomyelitis—MRI is best test)

CLINICAL box

Clinical Box: Full Septic Workup

- Blood culture
- Urine culture
- Lumbar puncture—CSF culture
- ± CXR in presence of respiratory symptoms
- Note: also consider nasopharyngeal swab for viruses, throat swab, and stool for virology/bacteriology/parasitology, if indicated based on symptoms/exposure Hx

CLINICAL box

Rochester Criteria for Infants at Low Risk of Serious Bacterial Illness

1. Previously healthy term infant without perinatal complications and no previous antibiotic treatment
2. Normal physical exam findings
3. White blood cell count: 5,000 to 15,000 cells/mm^3
4. Band count: < 1,500 cells/mm^3
5. Urinalysis: < 10 white blood cells/HPF in centrifuged catheterized specimen

A partial septic workup can be considered in febrile infants 1 to 3 mo of age who are at low risk of having a serious bacterial illness.

CLINICAL box

Signs of Sepsis on Exam

Early: peripheral vasodilation (tachycardia, bounding pulses, warm extremities, adequate capillary refill)

Late: poor distal perfusion (cool extremities, delayed capillary refill, altered mental status, ↓ urine output)

Septic shock (inadequate organ function/perfusion):

- Altered level of consciousness
- Hypoxemia
- Oliguria (< 0.5 mL/kg/h)

Educating Parents about Fever

- It is important to inform parents that fever is the body's normal response to infection, and is not usually harmful.
- Treatment of fever should be directed at the child's symptoms (↓ energy, ↑ myalgias, etc.) and not at the absolute value of the fever.
- If the fever is consistently present for > 2 d, the child should be evaluated by a physician for a source that may require treatment (i.e., if antibiotic therapy is warranted)

CanMeD

Diagnosis

The diagnostic evaluation of a child with fever without a source can be categorized by age. However, there are other important factors to consider as well—such as whether the child appears unwell (toxic vs. nontoxic), the family's reliability or ability to seek further care (i.e., access to transportation), or the concern of the family (parents know their children best!). For infants between 1 to 3 mo of age, the extent of the diagnostic evaluation performed is often dependent on these other factors.

Management

Management will vary depending on the etiology of the fever. If the fever is likely due to a viral infection, the family can be counseled about the role and appropriate management of fever (see CanMED Box). For example, the recommended dosage of acetaminophen is 10 to 15 mg/kg given every 4 h (to a maximum of 75 mg/kg/d or 4 g, whichever is less), and ibuprofen is 10 mg/kg given every 6 h (to a maximum of 40 mg/kg/d).

CLINICAL box

Jones Criteria for Acute Rheumatic Fever

Dx: 2 major criteria or 1 major + 2 minor + evidence of recent GAS infection (positive culture or rising titers)

MAJOR: "SPACE"

Subcutaneous nodules, Polyarthritis, Arthritis, Carditis, erythema marginatum

MINOR: "LEAF"

Long PR interval, elevated acute-phase reactants, Arthralgia, Fever

CLINICAL box

GAS Pharyngitis

- GAS accounts for 15% to 30% of pharyngitis in school-aged children.
- Dx: by throat culture (gold standard) or rapid antigen detection test
- Treatment: Penicillin V K or Amoxicillin solution. If allergic, cephalosporins or macrolides may be used.
- Must be treated to prevent suppurative and nonsuppurative complications (see Clinical Box, Jones Criteria for Acute Rheumatic Fever)

For common organisms and empiric antibiotic options by age-group, please see Table 18.10. For common organisms and antibiotic options by type of infection, please see Table 18.11; however, it is important to consider local resistance patterns when selecting antimicrobial therapy. If a serious bacterial infection or sepsis is suspected, the patient should be initially resuscitated using the management guidelines below, and treatment initiated prior to transfer to an admitting facility.

TABLE 18.10 • Common organisms and empiric treatment options by age

Age	Likely Organism	Empiric Treatment
Neonate (0–28 d)	**Common**: Group B Streptococcus, E. coli **Other**: S. aureus, Listeria monocytogenes, Enterococcus, herpes simplex virus, gram-negative organisms	Ampicillin + cefotaxime **or** ampicillin + aminoglycoside Consider acyclovir
Infant (29–90 d)	**Common**: S. pneumoniae, H. influenzae, N. meningitidis **Other**: Group B Streptococcus, E. coli, S. aureus, Enterococcus, Listeria monocytogenes, Pseudomonas sp., other gram-negative organisms	Ampicillin + cefotaxime Consider vancomycin for suspected meningitis
> 3 mo	S. pneumonia, H. influenza, N. meningitidis, S. aureus	Ceftriaxone ± vancomycin

TABLE 18.11 • Management of febrile illness

Infection	Common Bacterial Pathogen(s)	Empiric Antibiotic Treatment
Meningitis	N. meningitides, S. pneumoniae, HiB (now rare)	Third-generation cephalosporin (crosses BBB) + vancomycin
URTI	Pharyngitis: GABHS Acute otitis media: S. pneumoniae, NTHI, M. catarrhalis	Penicillin Amoxicillin
Pneumonia	S. pneumoniae, GABHS; atypicals	Ampicillin/amoxicillin or cefuroxime; macrolides
UTI	E. coli (**others**: Klebsiella, Enterococcus, Proteus, Serratia)	TMP-SMX; cephalexin or cefixime
Septic arthritis	S. aureus, Strep	Cloxacillin
Endocarditis	S. viridans (native valve)	IV penicillin G or ceftriaxone + gentamicin

- Assess
  - Airway—patent versus obstructed
  - Breathing—supplemental 100% O_2 by nonrebreather mask (consider bag mask ventilation ± intubation if not supporting airway), continuous pulse oximetry, assess work of breathing, and auscultate lung fields
  - Circulation—establish two sites of IV access, continuous cardiac monitoring, palpate peripheral pulses (if bounding, weak, etc.), extremities (warm vs. cold)
  - Laboratory investigations—CBC, culture, electrolytes, glucose, creatinine, urea, blood gas
- Support
  - If poor perfusion or low blood pressure, bolus with 20 mL/kg 0.9% normal saline (push as fast as possible) × 3
  - Consider vasopressors after 3 boluses are given—dopamine, norepinephrine, epinephrine—and transfer to ICU
- Treat
  - After appropriate cultures (blood, urine ± CSF) are collected, initiate broad-spectrum antibiotic treatment—early administration of antibiotics in suspected sepsis is essential.

!

ANTIBIOTICS CONTRAINDICATED IN CHILDREN

- **Fluoroquinolones**: impair bone/cartilage growth
- **Tetracyclines**: staining of teeth, damage growing cartilage

For a special discussion of influenza, see Table 18.12.

TABLE 18.12 • Special topic: Influenza

General overview	• Influenza causes significant morbidity and mortality. • Complications: bacterial pneumonia, Reye syndrome, encephalopathy, myositis, febrile seizures, dehydration, and worsening of chronic medical conditions (asthma, chronic pulmonary disease)
Prophylaxis	• Annual immunization recommended for children with chronic diseases and their contacts, and for all children between 6 mo and 2 yr of age • Antiviral drugs in patients not immunized or who may have suboptimal response to vaccine (chemoprophylaxis, see below)
Treatment	May be useful to reduce the severity and duration of symptoms if Dx confirmed by nasopharyngeal swab or viral culture. Indications: • ↑ Risk of severe or complicated influenza due to underlying chronic illness (± vaccination) • Healthy children with severe illness requiring hospitalization Antiviral medications: • Neuraminidase inhibitors—decrease release of influenza A and B from infected cells (oseltamivir [Tamiflu] and zanamivir) • Tricyclic amines—inhibit replication of influenza A (amantadine and rimantadine)

SORE THROAT AND RHINORRHEA

MCC OBJECTIVE

Based on Objective #100 (Sore Throat and/or Rhinorrhea) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Pharyngitis is often the result of bacterial or viral infection, but other causes should be considered and ruled out.

APPLIED SCIENTIFIC CONCEPT

- The presence of fever > 38°C, absence of cough, tonsillar exudates, tender anterior cervical lymphadenopathy, and patient age (3–14 yr) are all factors that should increase suspicion for GAS pharyngitis.
- A rapid strep antigen test can assist in making a Dx of GAS pharyngitis, while a throat culture is the gold standard.
- GAS pharyngitis can be treated with a 10-d course of penicillin or amoxicillin.

CAUSAL CONDITIONS

- Bacteria: for example, GAS
- Viral: for example, EBV, adenovirus, influenza, parainfluenza, coxsackie A virus
- Fungal: for example, *C. albicans* in immunosuppressed patients
- Allergic: for example, chronic allergic rhinosinusitis
- Other: for example, Kawasaki disease, foreign body, irritative pharyngitis

APPROACH (Table 18.13)

HISTORY

- Fever
- Respiratory distress—may suggest epiglottitis or peritonsillar/RPA

TABLE 18.13 • Upper airway disorders

Disease	Symptoms	Dx	treatment
Croup	URTI Hoarse voice + barking cough Fever Stridor	Lateral neck x-ray: subglottic narrowing Frontal (AP) neck film findings: classic "steeple sign" in subglottic region	Supportive Nebulized racemic epinephrine for stridor Single-dose systemic steroid
Bacterial tracheitis	Preceding URTI High fever Stridor, retractions Dysphagia Muffled, suppressed cough Toxic child	Clinical suspicion CXR: subglottic narrowing similar to croup Positive tracheal aspirate	Emergent intubation Empiric treatment IV antibiotics: cefuroxime
Epiglottitis	Rapid evolution symptoms: fever, sore throat irritability, lethargy, drooling Dysphagia Severe stridor, airway obstruction Toxic child	Clinical suspicion Direct visualization in OR	Keep in position of comfort Intubate IV antibiotics—third-/fourth-generation cephalosporin Steroids not indicated
RPA	Prodromal nasopharyngitis + abrupt onset high fever, dysphagia, respiratory distress Drooling Meningismus	Lateral neck x-ray: widening of retropharyngeal space	IV antibiotics: clindamycin, first- or second-generation cephalosporin and metronidazole Emergent surgical drainage
Peritonsillar abscess	Sore throat Ipsilateral ear pain Trismus "Hot potato voice" Fever	Mass effect: deviated uvula Cervical adenopathy Fluctuance WBC elevated Throat culture positive	Surgical drainage or tonsillar aspiration IV antibiotics

- Immunization status—higher likelihood of serious bacterial pathology, such as epiglottitis, in an unimmunized child
- Viral URTI symptoms (cough, rhinorrhea)
- Diagnostic criteria for Kawasaki disease

physical Exam

- General: if the child is unwell with stridor or drooling, must rule out airway obstruction (i.e., epiglottitis, foreign body, RPA)
- Lips: red/cracked lips may be a sign of Kawasaki disease.
- Oropharynx: erythematous, palatal petechiae
- Uvula: if deviated, may suggest presence of peritonsillar abscess
- Tonsils: presence of exudates, vesicles
- Lymph nodes: cervical LN enlarged, tender
- Must palpate for splenomegaly and hepatomegaly if suspicious of EBV
- Extremity changes: erythema/swelling/peeling are signs of Kawasaki disease.
- Remainder of HEENT exam and systemic exam

Investigations

- McIsaac criteria can help with the decision to do a throat swab for culture.
  - Age 3 to 14 yr (1 point)
  - Fever > 38°C (1 point)

  - Absence of cough (1 point)
  - Anterior cervical lymphadenopathy, tender on palpation (1 point)
  - Tonsillar exudates/erythema (1 point)
- 0 to 1 points: no culture; 2 to 3 points: culture but only treat if positive; 4 points: treat with antibiotics
- Other investigations to consider: rapid strep antigen test, heterophil antibody test (Monospot test), EBV titers, CBC + differential (presence of lymphocytosis in keeping with EBV)

Diagnosis

- A throat swab should always be obtained prior to starting treatment with antibiotics.
- Rapid strep antigen test is 70% to 90% sensitive; therefore, throat culture is still the gold standard.
- Complications of GAS pharyngitis include rheumatic fever, poststreptococcal glomerulonephritis, retropharyngeal/peritonsillar abscess, scarlet fever.
- Differentiation of bacterial versus viral pharyngitis is significant because inappropriate use of antibiotics to treat viral pharyngitis can contribute to antibiotic resistance.

Management

- GAS pharyngitis: penicillin G or amoxicillin for a 10-d course; erythromycin in cases of penicillin allergy
- Must treat GAS pharyngitis to prevent complications of rheumatic fever
- Consider referral to ENT for potential tonsillectomy if recurrent GAS tonsillitis
- EBV pharyngitis: supportive care; may need steroids if signs of airway obstruction; avoid contact sports for minimum of 4 wk in order to protect the spleen
- Acetaminophen for fever and pain management

RESPIRATORY DISTRESS IN CHILDREN

MCC OBJECTIVE

Based on Objective #27-3 (Pediatric Respiratory Distress) of *Objectives for the Qualifying Examination*, 3rd edition.

CLINICAL box

Normal Respiratory Rate by Age (Breaths per Minute)

0 to 3 mo—35 to 55
3 to 6 mo—30 to 45
6 to 12 mo—25 to 40
1 to 3 yr—20 to 30
3 to 6 yr—20 to 25
6 to 12 yr—14 to 22
> 12 yr—12 to 16

OVERVIEW

- Respiratory distress is a common pediatric emergency, characterized by increased work of breathing.
  - Signs of increased work of breathing include head bob, nasal flare, tracheal tug, substernal and intercostal retractions, subcostal recessions, paradoxical thoraco-abdo movement.
- It is important to recognize respiratory distress and intervene early, as young children and infants can quickly become fatigued and progress to respiratory failure, and potentially cardiopulmonary arrest.

A silent chest is an ominous sign for impending respiratory failure, and immediate intervention is needed.

APPLIED SCIENTIFIC CONCEPT

- Respiratory distress can lead to respiratory failure if corrective measures are not taken.
- Respiratory failure is defined by inadequate gas exchange (oxygenation or ventilation), and can be classified into Type I and Type II.
- Type I (hypoxemic) is characterized by decreased oxygen exchange ($Pao_2 < 60$ mm Hg).
  - This is most often due to ventilation-perfusion (V/Q) mismatch, but can also be caused by anemia, poor blood flow to the lungs (sepsis, cardiac failure), or toxins affecting the utilization of oxygen at a tissue level (cyanide).
- Type II (hypercapnic) is characterized by decreased removal of carbon dioxide ($Paco_2 > 50$ mm Hg or pH < 7.35)
  - This can be caused by decreased respiratory rate (bradypnea) or decreased tidal volume (shallow breaths).

CAUSAL CONDITIONS

The etiologies of respiratory distress in children can be categorized anatomically and by system (i.e., primary respiratory vs. cardiac). See Tables 18.14 and 18.15.

TABLE 18.14 • Causes of pediatric respiratory distress

Upper airway	• Croup • Epiglottitis • Laryngeal edema (postextubation) • Foreign body • RPA • Laryngomalacia • Tracheitis
Lower airway	• Bronchiolitis • Asthma • Allergy or anaphylaxis • Acute infectious (bacterial or viral pneumonia) • Chronic infectious (tuberculosis) • Tracheo-esophageal fistula • Cystic fibrosis • Bronchopulmonary dysplasia
Pulmonary vasculature	• Pulmonary embolism • Pulmonary vasoocclusive disease
Pleura	• Pneumothorax • Pleural effusion • Empyema
Neurologic	• Hypotonia • Myopathy (i.e., spinal muscular atrophy, botulism)
Cardiovascular	• Congestive heart failure
Metabolic	• Metabolic acidosis (DKA, metabolic conditions causing lactic acidosis)
Hematologic	• Acute hemolytic anemia • Sickle cell disease (chest crisis) • Carbon monoxide poisoning
Other	• Congenital diaphragmatic hernia • Scoliosis • Acute abdo • Mediastinal mass (malignancy) • Vascular ring • Cold • Exercise • Drug-induced (opiates)

APPROACH

History

Identification

- Age, PMHx, presenting symptoms

History of Present Illness

- Preceding events/exposures, duration of respiratory distress, aggravating/alleviating factors, associated symptoms, missed days of school, medications used and response, visits to health care practitioners or ED, any investigations already performed

CLINICAL box

Acute Management of Respiratory Distress

- Airway—ensure that the airway is patent
- Breathing—observe breathing and movement of chest wall/Abdo, auscultate lung fields, measure oxygen saturation, consider supplemental oxygen by face mask
- Circulation—blood pressure, heart rate, peripheral pulses, capillary refill time, consider IV access and laboratory investigations
- Obtain a SAMPLE Hx—Signs and symptoms, Allergies, Medications, PMHx, Last meal, Events surrounding the acute event
- Management—based on the clinical exam and Hx
- Call for help—EMS, if in hospital—respiratory therapy team or anesthesia

TABLE 18.15 • Bronchiolitis and asthma

Bronchiolitis	• Defined as a Hx of an URTI followed by increased work of breathing and wheeze in children between 1 mo and 2 yr of age • Characterized by inflammation, edema, and bronchospasm of the lower respiratory tract • Often due to respiratory syncytial virus (RSV); however, can be caused by other viruses causing lower respiratory tract infections (i.e., parainfluenza, human metapneumovirus, influenza, adenovirus) • ~10% of all children with bronchiolitis are hospitalized.
Asthma	• Chronic inflammatory disease of the lower respiratory tract • Characterized by inflammation, edema, bronchospasm, and airway hyperreactivity, resulting in reversible airflow obstruction • Can result in permanent changes to the airway structure and function • An asthma exacerbation is defined by the CPS as "an acute or subacute deterioration of symptom control that causes distress or risks health to the extent that a visit to the health care provider or treatment with systemic corticosteroids becomes necessary." • Approximately 11%–16% of Canadian children have asthma, and asthma exacerbations account for 3%–7% of ED visits in Canada.

Past Medical History

- Atopy (asthma, eczema, allergies), past ED visits or hospitalizations, admissions to ICU, other medical conditions (preterm, underlying cardiorespiratory disease), current medications (and compliance), known allergies, immunization status

Family History

- Atopy, genetic conditions (risk of congenital cardiac disease), cystic fibrosis, other major medical conditions

Social History

- Country of origin (recent immigration from country with different exposure risks—i.e., TB), exposure to smokers, pets, carpets/curtains, living situation, and other people in household (presence of wood-burning stove, contacts with communicable illnesses)

Review of Symptoms

- Recent viral URTI or current signs and symptoms (coryza, cough), sick contacts, exercise tolerance, nighttime cough, fever, emesis and voiding (as indicators of ability to tolerate feeding and hydration), dysphagia (RPA), drooling or hoarse voice (epiglottitis), travel Hx, Hx of choking episode (foreign body aspiration)

physical Exam

- Vital signs: tachycardia, tachypnea, decreased oxygen saturation, low BP, fever
- General: cyanosis, tripod positioning, unable to speak in full sentences
- HEENT: drooling, appearance of oropharynx (deviation of the uvula—peritonsillar abscess), sunken fontanelle and dry mucous membranes (if not tolerating fluids), lymphadenopathy (TB, malignancy), allergic shiners (dark coloration beneath eyes, can indicate atopy)
- Respiratory: increased work of breathing (described above, in Overview), inspiratory crackles, expiratory or biphasic wheeze or stridor, cough, localized or widespread reduced air entry, bronchial breath sounds
- Cardiovascular: extra or muffled heart sounds, murmurs, heaves, displaced point of maximal impulse, prolonged capillary refill time
- Abdo: paradoxical thoraco-abdo breathing, distended abdo, pain on palpation (referred from diaphragmatic inflammation due to an intrathoracic process), hepatomegaly
- Dermatologic: rash (postviral), erythematous pruritic patches (eczema)

- Neurologic: may be agitated, drowsy, or confused pelvic exam: in sexually active females with lower abdo pain
- Consider PRAM scoring (Table 18.16) as a method to quantify the level of respiratory distress

For any child in respiratory distress, it is extremely important to avoid further agitation. The physical exam should be performed with the child resting comfortably in his or her parent's lap.

CLINICAL box

Children may appear comfortable during mild respiratory distress. It is important to expose the entire chest and abdo to inspect for signs of work of breathing.

TABLE 18.16 • Pediatric respiratory assessment measure (PRAM)

Signs	0	1	2	3
Suprasternal indrawing	Absent	N/A	Present	N/A
Scalene retractions	Absent	N/A	Present	N/A
Wheezing	Absent	Expiratory only	Inspiratory only	Audible without stethoscope/silent chest
Air entry	Normal	Decreased at bases	Widespread decrease	Absent/minimal
Oxygen saturation on room air	> 95%	92%–94%	< 92%	

Score of 0 to 3: low risk
Score of 4 to 7: moderate risk
Score of > 8: high risk

Investigations

The use of investigations will be guided by the suspected underlying etiology. If bronchiolitis or an asthma exacerbation is suspected by Hx and physical exam, further investigations are not usually indicated. In general, the following investigations can be considered in a patient with respiratory distress.

A normal or increasing carbon dioxide level in the context of tachypnea and respiratory distress is an indicator of fatigue and impending respiratory failure!

Laboratory
- CBC and differential, electrolytes, creatinine, urea, glucose, ammonia
- Arterial or venous blood gas to evaluate oxygenation and ventilation (if significant respiratory distress)

Imaging
- AP and lateral CXR (not indicated in bronchiolitis or asthma. Useful for pneumonia, empyema, pulmonary edema, pneumothorax, cardiomegaly, rib fracture, mediastinal mass, etc.)
- Lateral neck radiograph (RPA, epiglottitis)
- Forced expiratory or bilateral decubitus chest radiograph (foreign body)

Other
- Electrocardiogram or echocardiogram

CLINICAL box

Retropharyngeal Abscess (RPA)

An RPA is a serious condition which may present with fever, neck pain (or torticollis), and refusal to eat. The classic finding on x-ray of the neck is increased width of the prevertebral soft tissue (In general, if it is greater than half of the width of the corresponding vertebral body, it is abnormal and an RPA should be considered.).

Diagnosis and Management

There are many etiologies of respiratory distress in children; therefore, the Dx and management of these will be dependent on a thorough Hx and physical exam.

Management of Bronchiolitis
- Supportive therapy, including suctioning of the nares to remove secretions (not deep suctioning), is key to the management of bronchiolitis.
- Provide supplemental oxygen to maintain saturations > 90%
- The use of bronchodilators is not currently recommended; however, a trial of bronchodilators is an option, particularly for children with a FHx of asthma or Hx of prior response to bronchodilators.
- Hospitalization is indicated for patients who are hypoxemic (unable to maintain their oxygenation > 90% on room air, after appropriate supportive therapy is initiated), unable to maintain their hydration status (generally for tachypnea > 60 breaths/min), or those who have underlying risk factors for severe bronchiolitis (preterm, significant cardiopulmonary disease).
- There is no evidence to support the use of systemic corticosteroids for bronchiolitis.
- Antiviral medications are not indicated, and antibiotics should be used only if there is evidence of a coexisting bacterial infection.
- High-risk children should receive RSV prophylaxis (palivizumab).

Management of an Acute Asthma Exacerbation

An acute episode of wheezing in patients with a Dx of asthma, or multiple episodes of wheeze responsive to bronchodilators, can be managed as described below. For more information on asthma in general, please see Chapter 21: Pulmonary Medicine.

Mild (PRAM Score 0–3)

- Provide supplemental oxygen as needed to maintain saturations > 94%
- Short-acting bronchodilator (Salbutamol) q20min × 1 to 3 doses, then q1h PRN
- Consider systemic steroids

Moderate (PRAM 4–7)

- Provide supplemental oxygen as needed to maintain saturations > 94%
- Continuous oxygen saturation monitoring
- Salbutamol ± Ipratropium bromide q20min × 3, then q30min PRN
- System steroids

Severe (PRAM > 8)

- Provide supplemental oxygen as needed to maintain saturations > 94%
- Continuous oxygen saturation monitoring
- Salbutamol and Ipratropium bromide q20min × 3, followed by salbutamol q30min PRN
- Systemic steroids—consider IV if not tolerating oral intake
- Consider IV fluids containing potassium
- If not improving, treat with magnesium sulfate
- If respiratory distress persists, consider continuous salbutamol infusion and admission to ICU
- Be prepared for rapid sequence intubation

CLINICAL box

Administration of Salbutamol

The ideal administration of salbutamol is by MDI via an AeroChamber; however, it can also be delivered via nebulizer.

CLINICAL box

Systemic Steroids in Asthma

The CPS recommends the following doses of oral corticosteroids:

> Prednisone (or prednisolone) 1 to 2 mg/kg/d (max 60 mg) or Dexamethasone 0.15 to 0.3 mg/kg/d (max 10 mg) for 3 to 5 d total course

Approach to the Child with Stridor

There are many conditions which can cause stridor in children. For an approach to common and life-threatening conditions causing stridor, please see Table 18.17.

TABLE 18.17 • Conditions causing stridor in children

Croup	• Inflammation of the larynx and trachea, often secondary to a viral infection (parainfluenza accounts for 65% of cases) • Occurs in children 1–6 yr of age • Hx: preceding viral URTI (cough, coryza, fever) • SSx: "barking" cough, inspiratory stridor • Ix: steeple sign on PA radiograph of upper airway • Tx: systemic steroids ± nebulized epinephrine
Epiglottitis	• Infection and inflammation of the epiglottis, with a high risk of upper airway obstruction • Most commonly due to HiB (important to ask about vaccination status of the child) • SSx: toxic appearance, drooling, muffled voice, tripod positioning • Ix: "thumb print sign" on lateral neck radiograph • Tx: intubation, antibiotics
Foreign body aspiration	• Must be considered in a stridorous child regardless of Hx • Peanuts are the most common aspirated foreign body in children. • Ix: AP radiographs can determine if there is a radiopaque object present; lateral decubitus radiographs may demonstrate air trapping on the side with the foreign body present. • Tx: bronchoscopy

!

Salbutamol shifts K^+ into cells, lowering serum K^+. If multiple treatments with salbutamol are required, K^+ must be monitored closely to prevent hypokalemia.

!

Anaphylaxis can mimic an asthma attack. If anaphylaxis is suspected, immediate treatment with IM epinephrine is required.

An essential part of the management of asthma is ensuring that the family and patient have the appropriate education about asthma and the recommended treatment (an asthma action plan).

Can MeD

COMMON RASHES OF CHILDHOOD

MCC OBJECTIVES

Based on Objectives #85 (Pruritus) and #97 (Skin Rash/Papules) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Rashes in childhood are very common, and it is important to differentiate benign from pathologic, treatable versus nontreatable, and initiate therapy as early as possible.
- Common and dangerous rashes will be discussed in this section.
- Please see Chapter 4: Dermatology for approach to dermatologic lesions as well as explanations around terminology

APPLIED SCIENTIFIC CONCEPT

- The different pathologic skin lesions affect different layers of the skin:
  - Epidermis: the outer layer of skin, contains melanocytes and Langerhans cells
  - Dermis: contains collagen, elastic tissue and reticular fibers, hair follicles, sebaceous (oil) and eccrine (sweat) glands, blood vessels, and nerves
  - Subcutis/hypodermis: contains subcutaneous fat and connective tissue
- Pruritus, or the desire to scratch, is a defining feature common to many pediatric rashes.
- The pathophysiology of pruritus is thought to reside in differential expression of cutaneous nerve fibers—a higher amount of sensory fibers, relative to the number of adrenergic autonomic nerve fibers.
- There are many neuropeptides (i.e., acetylcholine) and other mediators (i.e., histamine, IL-2) that have been shown to mediate pruritus.

CAUSAL CONDITIONS AND APPROACH

Neonatal Rashes

Erythema Toxicum

- Most common rash in neonates
- Noninfectious, benign papular rash that can evolve into vesicles. Clustered lesions, often developing within days of birth but up to few weeks of age
- Self-limited—resolution within a week
- Recurrences may occur.

Miliaria (Different than Milia)

- Papules and pustules on erythematous base usually around nose (“prickly heat rash”).
- Secondary to eccrine sweat duct obstruction
- Onset after first week of life, predilection for areas with high heat production
- Self-limited though supportive treatment; minimizing excessive wrapping can facilitate improvement.

Congenital Dermal Melanocytosis (Mongolian Blue Spot)

- Benign blue-purple large, usually patchy skin macules
- Common in Aboriginal, Asian, African American, and other dark-toned infants
- Sites: often buttocks, legs, spine but can occur anywhere
- Must ensure this is not an indication of nonaccidental injury
- Spontaneous resolution usually within a year, although some may persist

Molluscum Contagiosum: Poxvirus

- Small pink-tan (flesh-colored), dome-shaped papules with dimpled or umbilicated center. Can express curd-like material.
- Usually asymptomatic but can be associated with eczematous dermatitis and pruritus
- Rx: none—course is self-limited in healthy infants and children, with spontaneous regression within 2 yr.
  - Options include destructive methods (e.g., curettage, cryotherapy, peeling agents, topical retinoids, cantharidin).
- If persistent or widespread, screen for congenital or acquired immunodeficiency
- Complications: bacterial superinfection requiring antibiotic therapy

Hemangiomas

- In newborns seen as pale macules with thin telangiectasia (thread-like). In older children, vibrant red, elevated, noncompressible plaque sometimes with blue tinge indicating deeper components.
- Only approximately 10% present at birth; the remainder present within neonatal period and will progressively grow larger until 10 to 12 mo of age when natural regression can be seen over the subsequent 3 to 5 yr.
- **Complications:** rare, but can demonstrate ulceration with secondary infection, hemorrhage, and scarring
- **Dx:** clinical. If located in critical areas (eyes, nostrils, oropharynx, external auditory meatus, overlying liver or spleen), obtain U/S to differentiate vascular malformation or neoplastic process and visualize extent of deeper infiltration.
- **Rx:** none required in most cases. b-Blockers (nadolol, propanolol) are first-line therapy if located on face or otherwise requires treatment. Other therapeutic options include systemic steroids, laser ablation, interferon therapy, embolization, or surgical excision depending on number, location, and depth of lesions.

Epidermolysis Bullosa

- Group of heterogenous mechanobullous diseases characterized by development of blisters after trauma to skin
- **Types:**
  - EB simplex (nonscarring)
  - Dystrophic EB (severe scarring, atrophy, multisystem involvement)
  - Junctional EB (often fatal or heals with atrophy, can present with airway compromise due to granulation tissue)
- **Rx:** education, symptomatic management, monitor thermoregulation, fluid balance and airway patency, assess for secondary infections with extensive blistering, support groups; scarring can lead to internal and external deformities/strictures that have functional and cosmetic implications

Infectious Rashes

Viral Exanthem

- Morbilliform red eruption, usually nonpruritic
- Extremely common; a multitude of viral strains can cause this presentation
- May be febrile, well-appearing child
- Usual sites: trunk ± extremities
- Associated with measles, rubella, roseola, enteroviruses, mononucleosis
- **Rx:** self-limiting. Monitor for worsening symptoms or new developments

Chicken Pox—Varicella Zoster Virus

- Prodrome of mild fever and other systemic symptoms
- Generalized, polymorphous, pruritic, vesicular rash (“dew drop on a rose petal”) of abrupt onset at varying stages of healing evident
- Severe varicella infections are less common since vaccine introduction, and often present atypically.
- Latency in dorsal root ganglia during primary infection → reactivation → “shingles”
- Primary infection usually results in lifelong immunity, though recurrence can occur in healthy individuals.
- **Transmission:** airborne from respiratory secretions, direct contact of lesions, transplacental
  - **Incubation period:** 10 to 21 d. Contagious 1 to 2 d prior to onset of rash and until crusting of all lesions complete.
- **Dx:** clinical Dx sufficient. May send vesicular scrapings for direct fluorescent antigen/EM/PCR.
- **Rx:** supportive in healthy children. If immunocompromised, give acyclovir, VZIG ± vaccination depending on immunization status.
- **Complications:** bacterial superinfection, thrombocytopenia, arthritis, hepatitis, cerebellar ataxia, encephalitis, meningitis, glomerulonephritis, pneumonia
- **Perinatal/neonatal disease:** high risk if onset of maternal skin lesions 5 d before delivery or 2 d after delivery. Mortality rate approximately 30% due to encephalitis. Prevention with VZIG in immediate postpartum period. Rx with IV acyclovir if baby develops varicella.

Hand-Foot-and-Mouth Disease: Coxsackie Virus A16

- Red-colored macules, vesicular lesions on buccal mucosa, palate, tongue, hands (palms), and feet (soles)
- Viral prodrome
- Exquisitely tender lesions
- **Transmission:** direct contact
- **Rx:** supportive, ensure adequate fluid intake, lidocaine mouthwash

Measles: Morbillivirus

- Fever, cough, coryza, conjunctivitis (3Cs), diffuse maculopapular rash, transient enanthemas (Koplik spots—pathognomonic)
- Rash starting on face and spreading caudally
- Risk of death from respiratory and neurologic complications
- **Transmission:** respiratory droplet
- **Incubation period:** 8 to 12 d
- **Tx:** supportive + vitamin A supplementation; consider postexposure prophylaxis (vaccine/immunoglobulin); notify public health

Erythema Infectiosum (Fifth Disease): Parvovirus B19

- Prodrome of fever, malaise, myalgia approximately 7 d prior to rash onset
- Red “slapped cheek” rash with circumoral pallor
- Maculopapular, lace-like, pruritic rash on trunk, moving peripherally
- Other manifestations: polyarthropathies, anemia (immunocompromised), transient aplastic crisis (if have hemolytic anemia), hydrops fetalis (in first trimester of pregnancy)
- **Transmission:** respiratory droplet
- **Incubation period:** 4 to 14 + days
- **Rx:** supportive

Herpes Simplex Virus: HSV 1&2

- Primary infection usually asymptomatic
- Gingivostomatitis: fever, irritability, tender lymphadenopathy, ulcerative enanthem in the anterior oropharynx
- Genital herpes in adolescents
- **Recurrence:** grouped vesicles periorally or genital, conjunctivitis, herpetic whitlow
- **Transmission:** direct contact with secretions from lesions, sexual intercourse
- **Incubation period:** 2 d to 2 wk
- **Rx:** supportive, ensure adequate fluid intake, lidocaine mouthwash
- **Neonatal presentation:** incidence 1 in 3,200 to 10,000 neonates
  - Neonatal HSV classification:
    - **Localized skin, eye, and mouth (SEM):** coalescing/clustering vesicular lesions; tearing, ocular pain, conjunctival edema ± localized ulcerative lesions of mouth, palate, tongue
      - All SEM cases require a thorough evaluation for CNS and disseminated disease.
    - **CNS ± SEM**: seizures (focal or generalized), lethargy, irritability, tremors, poor feeding, temperature instability, and full anterior fontanelle
      - **EEG** often abnormal early on when CSF and neuroimaging remain normal
    - **Disseminated:** multiple organs. Often present in first week of life with nonspecific signs of neonatal sepsis (e.g., temperature dysregulation, apnea, irritability, lethargy, respiratory distress, abdo distension, ascites).
      - **Mortality** (untreated) > 8%
- **DDx:** mimic bacterial sepsis, meningitis, pneumonitis, hepatitis, and other viral illnesses (especially enterovirus). Early consideration of neonatal HSV is imperative to prompt Rx, which can be lifesaving. Early on, may present with merely persistent fever and negative BCx.
- **Ix:** culture-positive HSV, HSV DNA PCR, HSV antigens (rapid direct immunofluorescence/enzyme immunoassays). If CNS neonatal HSV? → EEG, LP, and neuroimaging.
  - **Note:** if negative, does **not** exclude HSV Dx

- **Rx:** empirical therapy with acyclovir where suspicion is high pending cultures, PCR, etc.

Roseola Infantum (Baby Measles): HHV 6

- High fever, then 3 to 5 d later → generalized maculopapular rash spreading from trunk to extremities, sparing face (note that the fever has subsided by the time the rash begins).
- **Transmission:** likely droplet
- **Peak incidence:** 6 to 24 mo
- **Incubation period:** 9 to 10 d
- **Rx:** supportive

Tinea Infections

- Can infect head (capitus), body (corporis), feet (pedis), face (faciei), groin (cruris)
- Many microorganisms cause disease—usually from family Tinea.
- Five clinical patterns of tinea capitis
  - Diffuse scaling
  - Circumscribed alopecia with scale
  - Black dots (broken hairs)
  - Kerion (boggy mass)
  - Pustular
- **Dx:** scraping for KOH and fungal culture
- Rx:
  - Tinea capitis—systemic therapy with oral terbinafine for 4 wk
  - All other types need only topical twice-daily therapy with any of the following: terbinafine, ciclopirox, clotrimazole, ketoconazole for up to 4 wk

Noninfectious Rashes (Table 18.18)

TABLE 18.18 • DDx of diaper rash

Disease	Lesions	Sites	Management
Irritant contact dermatitis (urine, feces)	Shiny red macules, patches, ulcerations, erosions	Perianal only	Frequently changed disposable diapers Emollients, e.g., petroleum jelly with barrier creams, e.g., zinc oxide 1% hydrocortisone cream t.i.d.
Seborrheic dermatitis (Cradle Cap)	Yellow, greasy plaques on base of erythema	Scalp, axillae, trunk, flexural surfaces	1% hydrocortisone cream t.i.d.
Candida	Beefy red patches with peripheral scales, i.e., "satellite lesions"	Flexural sites	1% hydrocortisone powder in clotrimazole cream t.i.d.
Psoriasis	Well-demarcated papules/plaques with thick silvery scale	Trunk, extremities, nails, scalp, flexural surfaces	Medium-potency topical steroids
Bullous impetigo	Bullae on erythematous base with erosions or crusts	All, including flexural surfaces	Antistaphylococcal systemic antibiotics
Langerhans cell histiocytosis	Hemorrhagic papules or plaques with scale, purpura, erosions, crust	Scalp, axillae, trunk, flexural surfaces	Moderate to potent topical steroids, psoralen and PUVA further workup and treatment for systemic disease including referral to an oncologist
Acrodermatitis enteropathica	Seen in zinc deficiency At 4–10 wk or when weaning off breast-feeds. Triad: dermatitis, alopecia, diarrhea	Scalp, perioral (perleche), anogenital area, digits, alopecia, red discoloration of hair (zebra hair)	Zinc sulfate

ABDOMINAL PAIN IN PEDIATRICS

MCC OBJECTIVE

Based on Objective #3-1 (Abdominal Pain [Children]) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- The DDx for pediatric abdo pain is broad and can be narrowed after consideration of the acuity and location of pain, as well as the age at presentation.
- Abdo pain may be the result of a serious pathology; acutely, intestinal obstructions of various etiologies must be considered, with midgut volvulus associated with malrotation being the most emergent pathology.
- A detailed Hx and physical exam are essential for the differentiation of organic from functional sources of abdo pain, and the determination of the need for further investigation.

APPLIED SCIENTIFIC CONCEPT

- Visceral (splanchnic) pain: due to noxious stimuli (usually stretch) stimulating receptors of the visceral peritoneum, mesentery, or the muscle or mucosa of hollow organs. The associated afferent autonomic nerves have few nerve endings, innervate targets in a bilaterally symmetric fashion, are unmyelinated, and enter spinal cord at multiple levels. Thus, visceral pain is dull, poorly localized, and associated with the midline.
  - Pain generally sensed in areas corresponding to embryonic origin of affected structure:
    - Foregut (esophagus to duodenum at major duodenal papilla, liver, gallbladder, pancreas)—epigastric
    - Midgut (distal 2nd part of duodenum to proximal two-third of transverse colon)—periumbilical
    - Hindgut (distal one-third of transverse colon to rectum)—suprapubic/hypogastric
- Parietal (somatic) pain: due to noxious stimuli (stretch, inflammation/irritation, tearing) stimulating receptors of the parietal peritoneum, skin, or skeletal muscle. Associated somatic afferent nerves are numerous, myelinated, and transmit to a specific dorsal root ganglion. Thus, somatic pain is relatively more intense and localized, on the same side and dermatomal region as origin of pain.
- Referred pain: due to convergence/shared projections of somatic and/or visceral pain pathways in the CNS. For example, pneumonia may present as abdo pain due to parietal pleural pain referred to abdo wall.

CAUSAL CONDITIONS

Acute

Upper/Epigastric

- Hepatobiliary/pancreatic: acute hepatitis, cholecystitis, cholelithiasis, cholangitis,* acute pancreatitis
- Esophagus: foreign body ingestion, esophagitis (reflux, chemical, infective, traumatic)
- Stomach: gastritis, reactive gastropathy, or peptic ulcer (infectious, medications, autoimmune, stress, trauma), foreign body ingestion/bezoar, pyloric stenosis
- Small intestine: duodenal ulcer, small bowel volvulus*
- Spleen: infarction, rupture*
- Functional dyspepsia

Lower/Hypogastric

- Intestinal: gastroenteritis, constipation, appendicitis/Meckel diverticulitis causing focal peritonitis,* IBD
- Mesenteric lymphadenitis
- Urinary tract: UTI/pyelonephritis, urolithiasis
- Male genital: incarcerated inguinal hernia,* testicular torsion*
- Gynecologic: ectopic pregnancy,* threatened abortion, pelvic inflammatory disease, ovarian torsion,* endometriosis, dysmenorrhea, Mittelschmerz, hematocolpos

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*Surgical/medical emergencies

Generalized or Periumbilical

- Intestinal
  - Inflammatory: infectious gastroenteritis, appendicitis,* Meckel diverticulitis,* allergy, IBD, Henoch-Schonlein Purpura (HSP), Hirschsprung, or necrotizing enterocolitis*
  - Obstruction*/dysmotility: constipation, Hirschsprung disease (HD), intussusception, malrotation with volvulus, meconium ileus, distal intestinal obstruction syndrome (DIOS), appendicitis, Meckel diverticulitis, adhesions, duodenal/intestinal atresia, bezoar/foreign body, strictures
  - Malabsorption: secondary lactase deficiency, dietary protein-induced enteropathy/enterocolitis
- Peritoneal*: abdo trauma, ruptured viscus, primary/secondary bacterial peritonitis, autoinflammatory disease (e.g., Familial Mediterranean fever)
- Metabolic*: diabetic ketoacidosis, hypoglycemia, adrenal insufficiency
- Hematologic: sickle cell acute pain crisis, hemolytic uremic syndrome
- Drugs/toxins*: many (e.g., consider lead/iron poisoning, salicylates, acetaminophen)
- Referred: pneumonia, pharyngitis, myocarditis/pericarditis
- Infantile colic
- Functional abdo pain, irritable bowel syndrome, abdo migraine

Chronic (. 1–2 mo Duration)

Upper/Epigastric

- Esophagus: esophagitis (reflux, immunologic, infectious, systemic disease associated)
- Stomach: gastritis, reactive gastropathy, peptic ulcer (infections, medications, eosinophilic, immune-mediated), bezoar or foreign body
- Duodenum: peptic ulcer, inflammation (celiac disease, eosinophilic gastroenteritis)
- Hepatobiliary: biliary dyskinesia, chronic hepatitis, cholelithiasis, choledochal cyst
- Pancreatic: chronic pancreatitis, pancreatic pseudocyst
- Functional dyspepsia

Lower/Hypogastric

- Intestinal: gastroenteritis, constipation, IBD, malabsorption, polyps
- Functional abdo pain, irritable bowel syndrome
- Gynecologic: pelvic inflammatory disease, endometriosis
- Urinary tract: ureter pelvic junction obstruction, hydronephrosis, nephrolithiasis

Generalized or Periumbilical

- Intestinal
  - Inflammatory: IBD, infectious gastroenteritis (parasites, bacteria, viruses), celiac disease, allergy (eosinophilic gastroenteritis, food protein intolerance), collagen vascular disease
  - Obstruction/dysmotility: functional constipation, secondary constipation (HD, anorectal malformation, spinal cord abnormalities, etc.), strictures, malrotation (intermittent volvulus), intussusception
  - Malabsorption: carbohydrate intolerance (primary lactase deficiency, overfeeding or dietary excess of fermentable oligosaccharides, fructose, sorbitol, etc.), cystic fibrosis
- Metabolic: adrenal insufficiency, diabetes mellitus, thyroid disease
- Hematologic: hereditary angioedema, porphyria
- MSK: muscle strain
- Neoplastic/anatomic: abdo mass (nephroblastoma, neuroblastoma, germ cell tumor, etc.), GI duplication, polyps, hernias (diaphragmatic, internal, umbilical, inguinal), malrotation (Ladd bands)
- Functional abdo pain, irritable bowel syndrome, abdo migraine

Approach (Figure 18.5)

History

Identification

- Age, PMHx, presenting symptoms

History of Present Illness

- Tailor to age of presentation, acuity, and whether appears stable or unstable

Red Flags for an Organic Pathology

Pain features: progressive, localized (nonumbilical), wakes from sleep, radiates to shoulder, back, or groin

GI symptoms: dysphagia/odynophagia, anorexia, emesis (bilious, bloody, persistent), jaundice, absence of flatus/bowel movements, diarrhea (especially chronic and nocturnal), hematochezia/melena

Extraintestinal symptoms: unexplained fevers, weight loss/failure to thrive, decelerated linear growth velocity, oral ulcers, perirectal disease, arthritis, cough/dyspnea, dysuria/hematuria, vaginal discharge/bleeding, scrotal/pelvic pain

FHx: IBD, celiac disease, peptic ulcer disease

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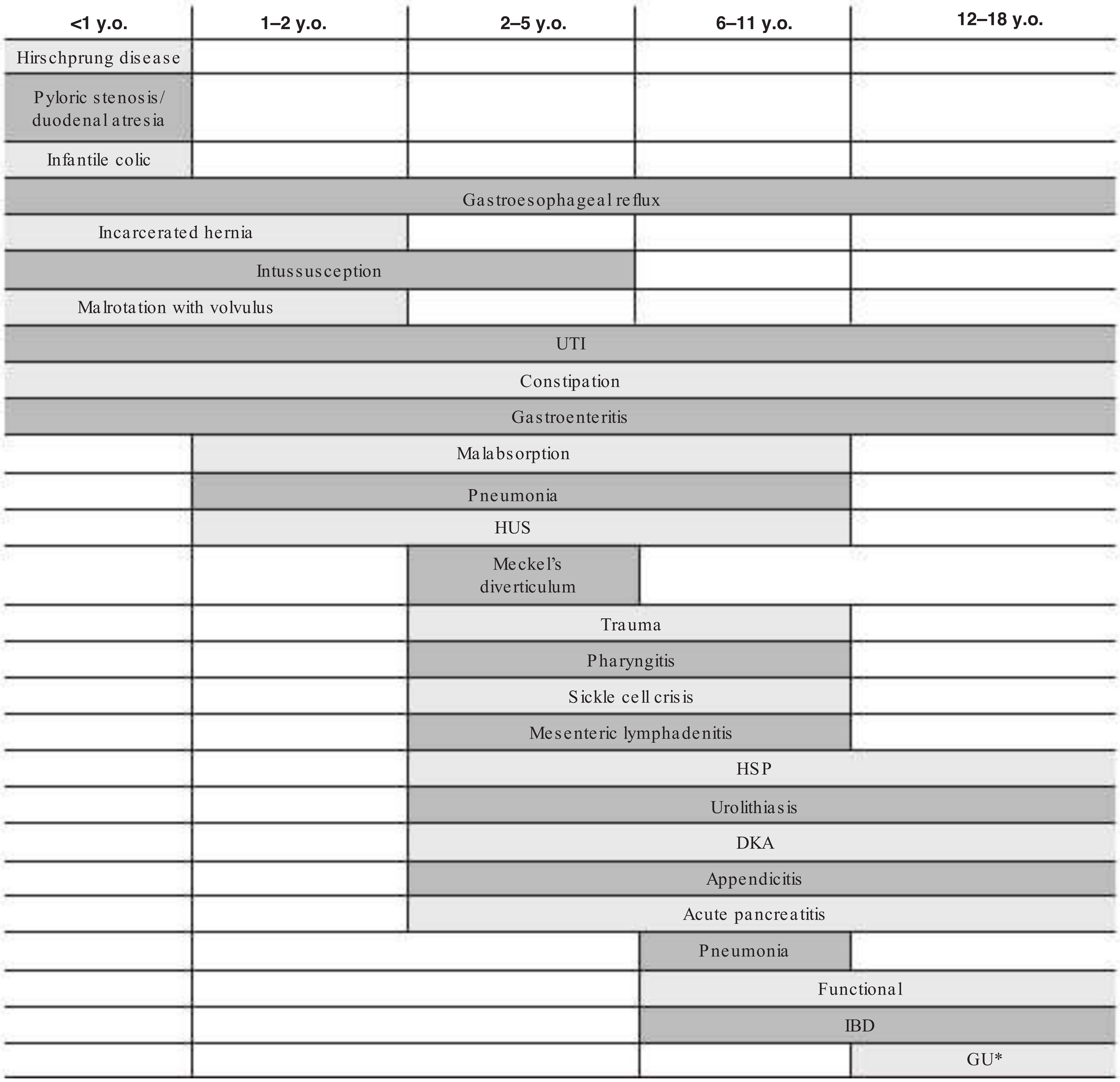
*Surgical/medical emergencies



* Includes testicular/ovarian torsion, endometriosis, ectopic pregnancy, threatened abortion, dysmenorrhea

Figure 18.5. Abdo pain: predominant ages of presentation.

- Features of pain: OPQRST (**O**nset/duration/**p**rogression/frequency, **P**alliating/**p**rovoking factors, **Q**uality, **R**adiation/location, **S**everity, **T**iming)
  - Provocation by: movement (peritoneal irritation), meal (pancreatitis, cholecystitis, gastric ulcer, GERD)
  - Palliation by: emesis (small bowel involvement), defecation (colonic condition), meal (duodenal ulcer)
- Associated symptoms: fever, weight loss
  - GI: anorexia, dysphagia, heartburn, vomiting (coffee ground), early satiety, diarrhea or constipation, last BM, melena, hematochezia, urgency/tenesmus, flatus/bloating/distension, jaundice
  - GU: dysuria, hematuria, polyuria, frequency/nocturia, scrotal pain, vaginal discharge/bleeding, and last menstrual period (normal/abnormal)
- Recent trauma, infections, treatments (and effects)

- Infectious risks: travel Hx, infectious contacts/animal exposures, uncooked food, untreated water

Past Medical History/PSHx

- If presentation in newborn/infancy—antenatal/perinatal/neonatal Hx, including age (hours/days) of first meconium
- Chronic medical conditions (e.g., sickle cell disease, diabetes mellitus, cystic fibrosis)
- Previous abdo surgeries (risk for adhesions, anastomotic complications)

Medications/Allergies/Immunizations

- Including OTC medications, alternative medicine

Nutrition

- Acute pain: time of last meal, relation to pain
- Chronic pain: variety, quantity, maladaptive eating habits, relation to pain (food diary)

FHx/SHx

- FHx of IBD, celiac disease, functional bowel disorders, etc.
- Adolescents—HEEADDSSS Hx (Home, Education, Employment, Activities, Drugs, Diet, Sexuality, Safety, Suicidal ideation/mood)
- Impacts on daily function (school absenteeism, activities, etc.) and family unit

Review of Systems

- Extraintestinal symptoms of organic disease

CLINICAL box

Evidence in Physical Exam of AAp

- Early analgesia in the initial evaluation of AAP effectively reduced pain intensity without impeding Dx of appendicitis.
- DRE has poor sensitivity for Dx of injuries to spinal cord, bowel, rectum, pelvis, or urethra in pediatric trauma assessments, and rarely alters management as part of assessment for suspected acute appendicitis.

physical Exam

- General appearance: comfort, positioning, level of consciousness, ill-appearance, malnutrition
- Vitals/anthropometrics: abnormal growth parameters (failure to thrive), fever, tachypnea/desaturation, hypotension, or unexplained tachycardia
- Skin: bruising, petechiae/purpura, jaundice, erythema nodosum, dermatitis herpetiformis, etc.
- HEENT/respiratory: conjunctivitis/episcleritis, oral lesions, cheilitis/glossitis, pharyngeal erythema/exudate, lymphadenopathy, thyromegaly, findings consistent with respiratory infection
- Cardiovascular: delayed capillary refill, diminished peripheral pulses, muffled/additional heart sounds
- Abdo exam: surgical scars, distention, visible bowel loops, altered bowel sounds, focal tenderness, peritoneal irritation (percussive or rebound tenderness, involuntary guarding), masses, hepatosplenomegaly, ascites
- DRE: local tenderness, mass, hard stool, blood
- Perianal/GU: perianal skin tag/abscess, hemorrhoids, anal fissure, imperforate anus, scrotal swelling, incarcerated hernia
- Pelvic exam: in sexually active females with lower abdo pain

Investigations

Routine

- No additional evaluation required for children with abdo pain who are otherwise healthy, with normal physical exam and absence of "red flags" for organic disease

Laboratory Tests

- CBC/differential: high WBC/Plt (infectious/inflammatory), anemia (MAHA, hemoglobinopathy)
- Serum electrolytes, glucose, creatinine, BUN (metabolic acidosis, DKA, renal pathology, or hypovolemia)
- Total/direct bilirubin, transaminases, GGT, ALP, amylase, lipase (hepatic, biliary, pancreatic pathology)
- Antitissue transglutaminase and IgA level (celiac disease screen)
- Serum/urine b-hCG (if postmenarcheal female)
- Stool for O&P × 3, C&S, *C. difficile* PCR, viral culture/electron microscopy
- Consider stool for fecal fat, occult blood, WBC, reducing substances
- Urine R+M, C+S if indicated
- Throat swab for culture (streptococcal pharyngitis)
- Urea breath test or stool *H. pylori* antigen assay (*H. pylori* screen)

- Consider vaginal swabs or urine testing for chlamydia, gonorrhea, trichomonas (if microscopy available)

Imaging

- CXR: pulmonary disease, cardiomegaly (myocarditis), foreign body
- AXR (three views include upright view with visible diaphragms): free air under diaphragm (pneumoperitoneum with ruptured viscus), bowel obstruction/volvulus, nephrolithiasis, constipation, foreign body
- CT abdo (appendicitis, pancreatitis, intra-abdo abscess, mesenteric ischemia, Abdo mass)
- U/S abdo (cholelithiasis, cholecystitis, intussusception, appendicitis, hydronephrosis, obstruction)
- U/S bowel wall or MR enterography (if suspect IBD with small bowel involvement—unable to be determined on upper endoscopy or colonoscopy)
- U/S pelvis/scrotum (testicular torsion, gynecologic pathology)

Diagnosis

- Refer to Table 18.19
- Mainly clinical diagnoses: HSP, appendicitis, infantile colic, incarcerated hernia, gastroenteritis, GERD
- Duodenal atresia—if AXR shows double bubble, UGI is still suggested preoperatively (rule out malrotation with midgut volvulus)

TABLE 18.19 • Characteristics of specific conditions of Abdo pain

Condition	hx	Physical exam	Investigations
HD	Delayed meconium FTT Bilious vomiting Chronic constipation since birth	Abdo distension DRE: tight anal sphincter, empty ampulla, blast sign (expulsion of gas and stool after DRE)	Barium enema: narrow/normal rectum, dilated colon proximal to aganglionic segment, with transition zone Definitive Dx by rectal biopsy: absence of ganglion cells
Pyloric stenosis	Symptom onset 3–8 wk old FTT, "hungry vomiter" M > F Projectile nonbilious vomiting, immediately postprandial	± Visible peristalsis Possible palpable epigastric mass ("olive sign")	U/S: hypertrophied pylorus (increased muscle thickness and length) Lytes/blood gas: hypochloremic, hypokalemic metabolic alkalosis
Duodenal atresia	Bilious vomiting within hours of birth (later if stenosis)	Epigastric distension ¼ have trisomy 21	AXR: "double bubble" sign, absent distal abdo gas Upper GI series: duodenal obstruction
Infantile colic	Unexplained paroxysms of irritability, fussiness, or crying starting/stopping without obvious cause, in < 4 mo old episodes of ≥ 3 h/d, ≥ 3 d/wk, for ≥ 1 wk No failure to thrive	Healthy appearing infant	Clinical Dx (Rome III criteria)
Gastroesophageal reflux/GERD	Regurgitation/emesis, feeding aversion, "colicky baby," irritable Apnea, stridor, aspiration, wheeze Sandifer syndrome: back arching, chin lifting, neck contortions due to discomfort	± FTT (in GERD) ± Hoarseness/stridor/wheeze	Empiric trial of acid suppressant Endoscopy: esophagitis 24-h ph probe/impedance study: acidic/nonacidic reflux, strength of association with suspected signs/symptoms ± Upper GI series: R/O obstruction/stenosis, malrotation
Incarcerated inguinal hernia	Classic Hx = swelling in inguinal area during crying/straining Irritable and crying Vomiting, abdo distension Groin pain	Firm, tender, often edematous inguinal mass ± Surrounding erythema ± Abdo distension/tenderness ± Scrotum appear blue due to testicular venous congestion	Clinical AXR (may see lower GI obstruction or air bubble in groin) U/S

TABLE 18.19 • Continued

Condition	hx	Physical exam	Investigations
Intussusception	3 mo to 3 y.o. (up to 6 y.o.) Paroxysmal, severe, crampy abdo pain, inconsolable crying, drawing up legs Episodes progress in frequency ± Vomiting Currant jelly stool (blood/ mucous) Initially comfortable/normal behavior between episodes; progressive lethargy	Abdo may be benign vs. variable abdo distension and tenderness ± Palpable sausage-shaped RUQ or epigastric mass ± Bloody mucus on DRE	Air contrast enema: obstruction (filling defect), air fluid levels, absence of gas in RLQ U/S: target sign (bowel within bowel), tubular mass
Malrotation with midgut volvulus	Sudden onset bilious emesis, abdo distension, melena Septic shock (necrotic bowel and 3rd spacing) Children may have episodic abdo pain with vomiting for weeks to years before detection	Abdo distension/tenderness ± Peritonitis/shock	AXR: upper GI obstruction (dilated proximal loops with fairly gasless abdo), pneumoperitoneum Upper gI series: failure of duodenum to cross midline (malrotation), duodenal obstruction (volvulus)
UTI	Dysuria, urgency, frequency Irritability, fever, poor feeding Vomiting or diarrhea Flank or abdo pain	Tender abdo (suprapubic) ± Costovertebral angle tenderness—Murphy punch sign (in pyelonephritis) ± Fever	Urine R&M (WBC, nitrites, leukocyte esterase), C&S Controversy in workup after 1st UTI: renal U/S ± VCUG
Constipation	BMs: 2 or less per week, large diameter, difficult/incomplete evacuation Colicky abdo pain, painful defecation ± Encopresis ± Retentive posturing	Abdo palpation of hard fecal mass Dilated rectum filled with stool ± Anal fissure	Clinical (Rome criteria for functional constipation) AXR: fecal impaction (excessive stool in colon)
Gastroenteritis (70%–80% viral, 10%–20% bacterial, 5% parasitic)	Fever, cramping abdo pain Diarrhea, ± BRBPR Vomiting, anorexia H/A, myalgia	Soft, tender abdo Fever possible	Stool C&S, stool O&P, Stool C. difficile PCR (only send if bloody or chronic diarrhea, immunosuppressed, recent antibiotic use, or exposures to bacterial/parasitic disease)
Pneumonia	Respiratory tract symptoms N/V Chest and/or upper abdo pain	Tachypnea, hypoxia, increased WOB, fever Percussion dullness, increased tactile fremitus, decreased air entry, bronchial breath sounds	CXR: focal consolidation, pleural effusion (atypical pneumonia w/ patchy diffuse opacifications) Possible ↑ WBC
HUS (E. coli 0157:H7, Shigella)	Preceding gastroenteritis, fever, bloody diarrhea (5–10 d) Abrupt onset of irritability, lethargy, edema, pallor (usually without purpura)	Toxic, ± uremic encephalopathy Tender abdo Hypertension	CBCD, blood smear, haptoglobin & bilirubin: MAHA, thrombocytopenia Cr: ↑ (ARF) U/A: proteinuria, hematuria Stool C&S: infection
HSP	Colicky abdo pain associated with vomiting (within 8 d of purpuric rash) Melena/hematochezia Arthralgias Hematuria Rare GI complications: intussusception, pancreatitis, protein-losing enteropathy	Palpable purpura on lower extremities/gravity dependent areas) Oligoarthritis ± Hypertension	No lab findings diagnostic Common: increased ESR, CRP, WBC, platelets; anemia IgA: elevated in 50%–70% INR/PTT: no coagulopathy ± Hematuria, proteinuria, ↑ Cr Biopsy skin/kidney (rarely needed); IgA deposition, leukocytoclastic vasculitis

(Continued)

TABLE 18.19 • Continued

Condition	hx	Physical exam	Investigations
Urolithiasis	Colicky abdo/flank pain, radiating to testes or labia N/V, chills, ileus Gross hematuria, dysuria, urgency	Fever Abdo ± costovertebral angle tenderness	Radiopaque stones on AXR; Non-contrast Ct gold standard U/S: obstruction of GU system, Hydronephrosis
DKA	N/V, anorexia Dehydration, weight loss Fatigue Polyuria, polydipsia, polyphagia	Dehydration Diffuse abdo tenderness Kussmaul breathing	↑ Blood glucose (> 11.1 mM) ABG: WAG metabolic acidosis (Hco_3 < 15, pH < 7.3) Positive urine/serum ketones ± ↑ WBC, Cr, and BUN (hemoconcentration)
Appendicitis	Periumbilical pain, migrating to RLQ (worse with cough, walking, jumping) Anorexia, nausea, vomiting	Fever RLQ tenderness (percussion and palpation)—often focal at McBurney point ± Peritonism: rebound tenderness, involuntary guarding, Rovsing sign, Obturator sign, Iliopsoas sign	U/S: thick-walled/dilated appendix ± appendicolith CT: enlarged appendix, appendicolith, associated mesenteric fat stranding ± ↑ WBC, ↑ neutrophils
Pancreatitis	Severe persistent epigastric/LUQ pain radiating to back, alleviated by bending forward Anorexia, vomiting Restlessness, agitation	Fever, tachycardia Tender ± distended abdo Periumbilical or flank bruising (hemorrhage)—very rare in pediatrics	↑ lipase, ↑ WBC U/S: hypoechoic enlarged pancreas ± gallstones CT: edema, necrosis, hemorrhage, peripancreatic fat stranding, pseudocyst
Cholecystitis	Epigastric/RUQ pain steady, severe ± radiation to shoulder/back, worse with motion Preceded by/associated with fatty meal Anorexia, N/V	Fever, tachycardia Tender abdo ± guarding ± Murphy sign	U/S: thick wall, gallstones, dilated gallbladder ↑ WBC Bili, ALP, GGT usually normal hIDA: nonvisualized gallbladder
IBD	FTT/weight loss, fatigue Growth failure, pubertal delay Red eyes, mouth ulcers Abdo pain Perianal disease Diarrhea ± blood, mucus/pus, urgency, tenesmus Arthralgia, rashes	Tender abdo ± RLQ mass Extraintestinal: fever, episcleritis, oral ulcers, pallor, digital clubbing, erythema nodosum, pyoderma gangrenosum, arthritis/sacroiliitis, perianal disease	Anemia (iron deficiency and chronic inflammation) ↑ WBC and Plts, ↑ ESR/CRP Low albumin, vitamin D Stool positive for blood, WBC Upper endoscopy/colonoscopy, small bowel imaging
Testicular torsion	Severe sudden onset testicular or scrotal pain, ± inguinal/lower Abdo pain Nausea, vomiting ± fever	Tender, swollen testicle, elevated ± horizontal lie Absent ipsilateral cremasteric reflex	Scrotal doppler U/S: compromised testicular perfusion
Ectopic pregnancy	Sexually active Missed period Vaginal bleeding, pelvic pain	Painful internal pelvic exam ± Peritonitis	ä serum a-hCg (slow rise) Pelvic U/S: absent intrauterine fetus ± visible ectopic pregnancy
Endometriosis	Dysmenorrhea ± Acyclic pelvic pain Abnormal vaginal bleeding Urgency, dysuria Dyschezia, constipation	General pelvic tenderness ± Tender uterosacral ligaments, posterior uterus ± Fixed uterine retroversion	Pregnancy test negative Pelvic U/S: excludes other pathology, may see endometrioma Laparoscopy
Ovarian torsion	Sudden unilateral abdo/pelvic pain ± N/V	Painful unilateral adnexa ± Peritonitis	Pregnancy test negative Pelvic U/S: ovarian torsion

CLINICAL box

infants

Determine whether an acute organic cause for the pain exists and differentiate from infantile colic or constipation

!

Suspect GERD in infants with failure to thrive

CLINICAL box

Rome III Criteria for Functional Chronic Abdo pain disorders

- All functional disorders → no evidence of inflammatory, anatomic, metabolic, or neoplastic process to otherwise explain symptoms
- Functional dyspepsia: persistent/recurrent upper abdo pain/discomfort, ≥ 1× /wk for ≥ 2 mo
- Irritable bowel syndrome: abdo pain/discomfort with ≥ 2 of 3 (pain improved by defecation, associated with change in frequency of stool or form of stool) for ≥ 25% of the time, ≥ 1× /wk for ≥ 2 mo
- Childhood functional abdo pain: episodic/continuous abdo pain, ≥ 1× /wk for ≥ 2 mo
- Childhood functional Abdo pain syndrome: functional Abdo pain ≥ 25% of the time, with some loss of daily activity, headache, limb pain, or difficulty sleeping
- Abdo migraine: intense periumbilical pain for ≥ 1 h, interferes with normal activities, associated with ≥ 2 of 6 (headache, photophobia, nausea, vomiting, pallor, anorexia), intervening usual health
- "Recurrent abdo pain" (Rome II): ≥ 3 episodes of pain severe enough to affect daily activities over ≥ 3 mo

CLINICAL box

HUS Triad

1. Acute kidney injury
2. Thrombocytopenia
3. Microangiopathic hemolytic anemia

CLINICAL box

Pediatric Appendicitis Score (PAS)

1 point for each of:

(1) Anorexia, (2) nausea or vomiting, (3) migration of pain, (4) fever > 38°C, (5) WBC > 10×10^6/L, (6) neutrophils + band forms > 7.5×10^6 cells/L

2 points for each of:

(7) RLQ tenderness, (8) pain with cough or percussion

PAS ≤2: low risk; PAS 3 to 6: intermediate risk → consider surgical consultation, serial exams; PAS ≥ 7: high risk → surgical consultation warranted

CLINICAL box

DKA Precipitants

- Insulin deficiency (new Dx or missed insulin dose)
- Infection
- Ischemia
- Intoxication

Management (Table 18.20)

TABLE 18.20 • Management of Abdo pain by causal condition

Condition	Medical/Conservative Management	Surgical Management
Constipation	Diet modification, bowel routine, increased fluids, behavior modification	
Gastroenteritis	Oral/IV rehydration; treat etiology	
UTI	Antibiotics	
Functional/infantile colic	Patient/parent education, reassurance Address psychosocial issues Consider: allergy, probiotics	
Pancreatitis	Aggressive fluid resuscitation Monitor/correct electrolyte/metabolic disturbances Pancreatic rest (NPO vs. low-fat semi-elemental feeds) if pain limiting intake Pain management Broad-spectrum antibiotics if necrosis Treat etiology	
HSP	Supportive: rest, hydration, nutritional support, analgesia PRN Systemic corticosteroids for severe GI involvement (controversial)	
HUS	Monitor/correct fluids and lytes Red cell and Plt transfusions PRN Strict control of hypertension and nutrition; possible dialysis	

(Continued)

TABLE 18.20 • Continued

Condition	Medical/Conservative Management	Surgical Management
Acute intestinal obstruction	Stabilize ABCs IV fluid resuscitation Broad-spectrum antibiotics if suspect necrosis/perforation NPO/NG tube decompression Treat etiology	If necrosis/perforation If no improvement within ~24 h If "de novo" or closed-loop obstruction
Appendicitis	IV antibiotics if perforated	Appendectomy
Intussusception	IV resuscitation, NG decompression Reduction with air contrast enema	If symptoms >24 h or signs of peritonitis
Incarcerated hernia	Nonoperative reduction with sedation/analgesia if nonstrangulating	If unable to reduce or signs of peritonitis
IBD	Immunosuppressive therapy (induction agent) once exclude active infection	Bowel resection/stricturoplasty if obstruction refractory to medical management
Pyloric stenosis	IV resuscitation and correction of electrolyte derangements if present	Pyloromyotomy
Malrotation with midgut volvulus	Fluid resuscitation if hemodynamically unstable	Laparotomy with Ladd procedure
Duodenal atresia/stenosis		Duodenoduodenostomy or duodenojejunostomy
Testicular torsion	Attempt at manual detorsion with sedation/analgesia	Detorsion with orchiopexy or testicular removal (if necrotic)

PEDIATRIC DIARRHEA

MCC OBJECTIVE

Based on Objective #22-3 (Pediatric Diarrhea) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Diarrhea is defined as increased frequency, fluidity, and volume of stools.
  - WHO: unusually loose or watery stools, usually at least 3× /d
  - Stool volumes considered abnormal: > 10 g/kg/d (infants/toddlers), > 200 $g/m^2/d$ in older children
- Classified as acute (< 2–3 wk) or chronic (> 2–3 wk)
- Most acute cases are infectious-related and self-limiting.
- Chronic diarrhea after infancy in developing countries is often the result of malnutrition and serial infections, whereas in developed countries, it is mostly due to noninfectious processes.

APPLIED SCIENTIFIC CONCEPT

- Diarrhea results if small intestinal and/or colonic absorption is decreased or intestinal secretion is increased.
  - Normally, 8 to 10 L fluid/d (285 mL/kg/d in infant/young child) reaches the small intestine, and 1.5 L/d reaches cecum. The colon can absorb up to 3 to 5 L/d.
- Pathophysiologic mechanisms of diarrhea include:
  - **Osmotic:** ingested, nonabsorbed solutes reach colon, creating an osmotic gradient that allows water diffusion into the lumen (e.g., lactase deficiency).
  - **Secretory:** excessive secretion of electrolytes (especially Cl^-, through CFTR) into lumen after noxious stimulus, with water subsequently following (e.g., bacterial toxin)
  - **Altered motility:** increased motility results in reduced transit time for water absorption (e.g., ileocecal valve resection)
  - **Inflammation:** multifactorial—damage/atrophy of villi, epithelial cell dysfunction (e.g., altered fluid/electrolyte transport), and increased motility and secretions (e.g., infection, IBD)

CAUSAL CONDITIONS (Tables 18.21 and 18.22)

TABLE 18.21 • Acute causes of diarrhea

Infectious	Noninfectious
Viral: rotavirus, calicivirus (Norovirus, Sapovirus), enteric adenovirus, astrovirus	Medication-related: antibiotic-associated diarrhea, drug side effect
Bacterial: E. coli, Salmonella, Campylobacter, Shigella, Yersinia, Clostridium, Listeria	Allergy
Parasitic: Giardia lamblia, Entamoeba histolytica, Cryptosporidium, Cyclospora	Toxin ingestion (foodborne/other): bacterial, pesticide, heavy metal
	Acute abdo presenting as diarrhea: intussusception, appendicitis, toxic megacolon, evolving bowel obstruction

TABLE 18.22 • Chronic causes of diarrhea

- Enteric infection
- Postinfectious (villous atrophy)
- Immune-mediated
  - Celiac disease
  - IBD
  - Food protein-induced enteropathy (e.g., cow's milk protein intolerance)
  - Eosinophilic gastroenteritis
- Immune defects (1° or 2°)
- Functional
  - Toddler's diarrhea
  - Irritable bowel syndrome
- Fecal impaction (overflow incontinence)
  - Functional constipation
  - Secondary constipation (e.g., HD, anorectal malformation, dysmotility)
- Neuroendocrine
  - Hyperthyroidism
  - Neoplasm (gastrinoma, VIPoma, systemic mastocytosis, neuroblastoma)
- Short bowel syndrome
- Small intestinal bacterial overgrowth
- Carbohydrate malabsorption
  - Constitutional lactase deficiency (decreased intestinal lactase levels over time, genetically regulated)
  - Secondary disaccharidase deficiency (after mucosal injury)
  - Congenital (e.g., lactase or sucrase-isomaltase deficiency, glucose-galactose malabsorption)
  - Dietary (excess fructose/sorbitol)
- Fat maldigestion/malabsorption
  - Pancreatic exocrine insufficiency, e.g., cystic fibrosis
  - Intrahepatic/extrahepatic cholestasis
  - Bile acid metabolism/synthesis defects, ileal resection/disease
- Protein-losing gastroenteropathy
  - Mucosal erosion/ulceration
  - Intestinal lymphangiectasia (1°/2°)
- Transporter/metabolic defects
  - Congenital secretory diarrhea
  - Galactosemia, tyrosinemia

APPROACH

HISTORY

History of Present Illness

- Age of onset
- Rapidity of onset: abrupt versus gradual
  - Abrupt—think of infectious/toxic trigger
  - Gradual—must consider a broad differential
  - Duration, frequency of stools
- Other stool characteristics (PQST)
  - Palliating/provoking factors
    - Eating versus fasting
    - Specific triggers (diet, recent infection)

  - Quality
    - Blood or mucus—inflammatory diarrhea
    - Acholic—cholestasis
    - Foamy/floating/greasy/foul smell—steatorrhea (80% pancreatic insufficiency, 12%–15% mucosal disease)
    - Watery—malabsorption, secretory
    - Undigested particles—consistent with toddler's diarrhea
    - Small volume leakage/incontinence—consider constipation
  - Severity—volume of stools, symptoms of dehydration
  - Timing
    - Daytime only, looser as day progresses—suggests functional
    - Nocturnal—suspect organic disorder (secretory, inflammatory)
- Associated symptoms
  - FTT/weight loss—suspect malabsorption, anorexia nervosa, hyperthyroidism
  - Systemic (fever, rash, arthritis)—suspect infectious or immune-mediated, neuroendocrine diseases
  - Extraintestinal infectious symptoms—cough, shortness of breath, dysuria/frequency
  - Abdo pain
  - Flatus/cramping, diaper rash—carbohydrate malabsorption
  - Extraintestinal symptoms (e.g., red eye, joint pain), oral ulcers, perianal discharge/pain
- Infectious risks: travel to diarrhea-endemic area, infectious contacts, childcare attendance, outbreaks, animal exposures, raw vegetables/meats, contaminated water, use of antimicrobials

Past Medical History/PSHx

- Perinatal course—delayed meconium/constipation, gastroschisis, etc.
- Recurrent infections—HIV, immunoglobulin deficiencies, CF
- Previous radiation or surgery (especially resections of small intestine / large intestine)
- Prior growth and development

Medications/Allergies/Immunizations

- Medications, especially recent antibiotics, antacids, laxatives
- Allergic diseases (rhinitis, asthma)—risk for eosinophilic gastroenteritis
- Food allergies
- Immune status, including rotavirus ± hepatitis A

Nutrition

- "Sugar-free" foods/gum—sorbitol/mannitol
- Excessive juice or other sources of fructose
- Overfeeding

FHx

- Consanguinity
- Absorptive defects, IBD, celiac disease, metabolic, allergic disease

SHx

- IVDU, sexual promiscuity—HIV risk factors
- Body image, binge-purge/restrictive
- Alcohol abuse

physical Exam

- General appearance: comfort, ill-appearance, nutritional state (muscle mass, subcutaneous fat stores), pubertal stage, developmental observations
- Vitals, anthropometrics: fever, hypotension, unexplained tachycardia, abnormal growth parameters
- Integumentary/MSK: erythema nodosum, pyoderma gangrenosum, dermatitis herpetiformis, arthritis, poor skin turgor, cold extremities, sunken anterior fontanelle (infants), dry mucous membranes, etc.
- HEENT/respiratory: uveitis, oral aphthous ulcers, glossitis, facial dysmorphism, thyromegaly, respiratory findings consistent with CF
- Cardiovascular: delayed capillary refill, diminished peripheral pulses
- Abdo: tenderness, distension (obstruction, inflammation, malabsorption), organomegaly, mass
- Perianal exam: rectal prolapse, fistulae, fissures, skin tags, or excoriation

!

DIARRHEA RED FLAGS

- Severe continuous or nocturnal diarrhea
- Systemic symptoms: fever, rash, arthritis
- Blood or mucous in the stool
- Very acidic stools
- Weight loss/failure to thrive
- Petechiae or purpura
- Signs of dehydration
- Change in mental status
- Severe abdo pain or distension

Investigations

- Acute diarrhea
  - Investigations should be based on DDx, none needed in most previously well children with uncomplicated, watery diarrhea (most cases viral, self-limiting).
  - Stool C&S, O&P if bloody diarrhea, outbreaks with suspected HUS, immunosuppressed, recent travel to or exposure to endemic area
  - Stool for *C. difficile* if recent antibiotic use (past 12 wk) and bloody diarrhea ± systemic toxicity, fever or abdo pain **or** diarrhea in immunocompromised patient and recent antibiotic/chemotherapy
  - Consider: urine R&M, C&S if febrile and no other source of infection is identified, CXR if associated respiratory symptoms
  - Blood work and blood cultures if ill-appearing or significant dehydration requiring IV rehydration
  - Imaging studies (abdo U/S, computed tomography, and air contrast enema) if findings suggestive of intussusception, appendicitis, or an acute abdo
- Chronic diarrhea
  - In absence of red flags, may require minimal investigation (functional diarrhea is not necessarily Dx of exclusion).
  - Favor noninvasive testing
  - Initial blood work may include inflammatory parameters (ESR, CRP, PLT, WBC, and differential), Hgb and iron studies, electrolytes, calcium, total protein and albumin, INR, transaminases, lipase, celiac screen, and TSH.
  - Stool assessment for inflammation: fecal WBC ± calprotectin, infectious workup as above
  - Stool pH and electrolytes if watery stools, help distinguish between osmotic and secretory diarrhea:
    - Osmotic: $pH < 5$, osmotic gap > 125 mM, $Na^+ < 60$ mM
    - Secretory: $pH > 5$, osmotic gap < 50 mM, $Na^+ > 90$ mM
  - Suspected carbohydrate maldigestion/malabsorption
    - Stool for reducing substances
    - Lactose hydrogen breath test
  - Steatorrhea/suspected fat malabsorption
    - Tests of malabsorption: stool microscopy for fat globules, quantitative 72-h fecal fat collection
    - Screen for cholestasis: bilirubin (total/direct), GGT, ALP, vitamin A, D, and E levels, INR, triglycerides, cholesterol
    - Screen for pancreatic insufficiency: fecal elastase, sweat chloride
  - Suspected protein-losing enteropathy
    - Stool a$_1$-antitrypsin
    - Calcium, INR, albumin
  - Immunoglobulins: suspected immunodeficiency or eosinophilic gastroenteritis (IgE elevated in ~50% of cases)
  - Specialized tests if indicated: abdo U/S, upper GI series with small bowel follow through, endoscopy

Management

Acute Diarrhea

- Initial assessment of dehydration and fluid rehydration
  - Mild to moderate dehydration: rehydration with oral rehydration solution (ORS) (oral rehydration solution) over the first 4 h
  - Severe dehydration: IV resuscitation with normal saline or Ringer lactate for the first hour, with reassessment and repeated fluid boluses PRN. ORS can be started once stabilized.
  - Limitations to oral rehydration therapy: shock, ileus, intussusception, carbohydrate intolerance, severe emesis, or high stool output (> 10 mL/kg/h)
- Treat electrolyte imbalances; screen for systemic infections
- Continued enteral feeding with age-appropriate diet thereafter, with ORS continued to replace ongoing losses from emesis or stools
  - Early refeeding has clinical and nutritional benefits.
- Zinc supplementation can reduce duration and severity of diarrhea.
- Probiotics can reduce duration of acute viral diarrhea (five pediatric meta-analyses).
- Avoid fatty foods or foods high in simple sugars

CLINICAL box

Stool Osmotic Gap

- Estimates relative contributions of electrolytes and nonelectrolytes to retention of water in the intestinal lumen
- Normal stool osmolarity is 290 mmol/L (isotonic to plasma)
- Stool Na^+ and K^+ in stool multiplied by 2 in the equation to account for obligate anions
- Stool osmotic gap (mmol/L) = 290 (or measured stool osmolarity) − 2(stool $[Na^+]$ + stool $[K^+]$)

- Avoid carbonated drinks, sweetened fruit juices, and plain water
- Antibiotics should only be used in children with bloody diarrhea when a specific pathogen has been isolated. Antibiotics may increase the risk of hemolytic uremic syndrome in patients infected with *E. coli* 0157:H7.
- Antimotility agents contraindicated if bloody stools, also likely no role in management of acute, watery diarrhea in otherwise well children
- Further management depends on the underlying cause.

Chronic Diarrhea

- Management depends on the underlying cause, severity of dehydration, and/or malnutrition
- General dietary principles
    - Oral or enteral refeeding essential to stimulate mucosal recovery and avoid protracted diarrhea
        - Elemental or semi-elemental formulas and modular diets may be needed to allow for early refeeding
        - Poly/disaccharides—may increase diarrhea
    - Avoid restricted diets and parenteral nutrition, if possible
    - Long-chain triglycerides should be tried (osmotically inert, calorie dense, and absorbed variably in a variety of diseases).
- Antibiotics should only be used in children with bloody diarrhea when a specific pathogen has been isolated. Antibiotics may increase the risk of hemolytic uremic syndrome in patients infected with *E. coli* 0157:H7.
- Antimotility agents contraindicated if bloody stools, also likely no role in management of acute, watery diarrhea in otherwise well children
- Further management depends on the underlying cause.

PEDIATRIC CONSTIPATION

MCC OBJECTIVE

Based on Objective #16-2 (Pediatric Constipation) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Constipation is defined as infrequent, difficult, painful, or incomplete evacuation of hard stools.
- Constipation can lead to significant pain, change in eating habits, UTIs, and distress to child and family, and also has a significant impact on health care costs.
- Etiology is often multifactorial, rarely due to organic pathology.
- In 17% to 40% of children, constipation begins in first year of life.
- Constipation is common in childhood:
    - Prevalence between 0.3% and 28%
    - Accounts for approximately 3% of general pediatric outpatient visits, approximately 25% of pediatric gastroenterologist consultations
- Fecal impaction is defined as a hard mass in the lower abdo on exam, dilated rectum with large amount of stool on rectal exam, or excessive stool in distal colon on abdo x-rays.
- Encopresis is recurrent, episodic fecal incontinence (involuntary loss of stool into child's underwear, after reaching developmental age of 4 yr), due to overflow of stool caused by fecal impaction.

APPLIED SCIENTIFIC CONCEPT

- Normal defecation requires:
    - Involuntary phase, with normal colonic transit delivering fecal material to rectum
    - Voluntary phase, leading to expulsion of stool
- Control of colonic and rectal motor function involves neural input from enteric nervous system and autonomic nervous system.
- Constipation results from slowed colonic transit and/or dysfunctional evacuation/elimination.
    - Slowed colonic transit may be idiopathic or secondary to organic pathology.

CLINICAL box

Normal Number of Bowel Movements per Week in Healthy Children by Age

1. 0 to 3 mo, breast-fed: 5 to 40 (but may have up to 14 d intervals between soft to loose bowel movements, considered normal)
2. 0 to 3 mo, formula-fed: 5 to 28
3. 6 to 12 mo: 5 to 28
4. 1 to 3 yr: 4 to 21
5. > 3 yr: 3 to 14

  - Vast majority of functional constipation is secondary to purposeful/subconscious stool withholding (posturing with contraction of pelvic floor and gluteal muscles):
    - Pushes stool higher into rectum (diminishing urge to defecate)
    - Colon absorbs water and electrolytes from retained stool, with increasingly larger stool volume with harder consistency.
  - Chronic rectal distension is accompanied by decreased rectal sensitivity and loss of the normal urge to defecate.
  - Involuntary overflow soiling may then occur around mass of impacted stool (encopresis).

CAUSAL CONDITIONS

The underlying etiology of constipation can be divided into functional and organic causes.

Functional

- 95% to 99% of pediatric constipation
- Term denotes children with dysfunctional elimination, without evidence of an underlying pathologic condition.
- There are many causes of dysfunctional elimination.
  - **Situational:** toilet training, refusal to use school or public toilets, changes in routine, intercurrent illness, stressful events
  - **Dry stool, causing painful defecation:** infant formula/solid food introduction, low fiber in diet, dehydration/insufficient fluid intake, underfeeding/malnutrition
  - **Developmental:** cognitive impairments, ADHD
  - **Psychosocial:** mood/anxiety disorder (i.e., at the onset of school), sexual abuse, neglect
  - **Genetic predisposition** (positive FHx in 28%–50% of pediatric patients with constipation, higher incidence in monozygotic vs. dizygotic twins)
- Dx based on Hx and physical exam, Rome III criteria (Table 18.23)

TABLE 18.23 • Rome III diagnostic criteria for functional constipation

Neonates/toddlers (Developmental Age < 4 yr)	Children/Adolescents[a] (Developmental Age ≥ 4 yr)
In Absence of Organic Pathology, ≥2 of Following Must Occur	
1. ≤ 2 defecations/wk	1. ≤ 2 defecations in toilet/week
2. ≥ 1 episode fecal incontinence/week after acquiring toileting skills	2. ≥ 1 episode fecal incontinence/week after acquiring toileting skills
3. Excessive stool retention	3. Retentive posturing or excessive volitional stool retention
4. Painful/hard bowel movements	4. Painful/hard bowel movements
5. Large diameter stools that may obstruct toilet	5. Large diameter stools that may obstruct toilet
6. Large fecal mass in rectum	6. Large fecal mass in rectum
Criteria fulfilled for ≥ 1 mo	Criteria fulfilled ≥ 1×/wk, ≥ 2 mo

[a] In children/adolescents, must also exclude irritable bowel syndrome.

Organic

- Anatomic malformations: imperforate anus, anal stenosis, anteriorly displaced/ectopic anus
- Intra-abdo/pelvic mass: sacral teratoma
- Intestinal/anorectal nerve or muscle disorders: HD (Table 18.24), internal anal sphincter achalasia, colonic inertia, chronic intestinal pseudo-obstruction (visceral myopathies/neuropathies)
- Other GI disorders: celiac disease, cystic fibrosis
- CNS or neuromuscular anomalies/diseases: cerebral palsy, spinal cord anomaly (myelomeningocele), trauma, tethered cord, myotonic dystrophy
- Abnormal abdo musculature: prune-belly syndrome, gastroschisis, Down syndrome
- Metabolic disorders: hypothyroidism, hypercalcemia, hypokalemia, diabetes mellitus
- Connective tissue disorders: systemic lupus erythematosus, scleroderma, Ehlers-Danlos syndrome

TABLE 18.24 • Distinguishing between functional constipation and HD

	Functional Constipation	HD
Onset	Infancy/childhood	<1 mo
Passage of meconium >48 h	<1%	~50%
Failure to thrive	Unusual	Common
Abdo distension	Unusual	Common
Soiling/fecal incontinence	Common	Absent
Rectal exam	Palpable stool/fecal mass, large rectal vault	Tight, empty rectum, blast sign
Anal fissures	Common	Unusual

- Drugs/toxins: opiates, anticholinergics, sympathomimetics, antidepressants, chemotherapy, heavy metal ingestion (lead), vitamin D intoxication, botulism

APPROACH

History

History of Present Illness

- Age of onset and development of symptoms
- Precipitating factors: fissure, change of diet, toilet training, infections/intercurrent illness, stressful/major life event, starting school, fears and phobias, travel, new medications
- Stool characteristics
  - Frequency, quality (blood, mucous, etc.)
  - Consistency using objective scale (e.g., modified Bristol Stool Form Scale for children, Amsterdam infant stool scale, etc.)
- Stool withholding maneuvers/behaviors: time course, frequency, settings
- Associated symptoms/complications
  - Change in appetite, nausea or vomiting
  - Weight loss
  - Fecal incontinence (timing, settings)
  - Pain
  - Perianal fissures, dermatitis, abscess, or fistula
  - Urinary retention or incontinence, UTIs
- Treatment Hx
  - 3-d diary of dietary/fluid intake
  - Medications used (oral laxative, enema, suppository, herbal/other)
  - Adherence of parents/patient to and success of any therapy

Past Medical History/PSHx

- Perinatal course—gestational age, time of passage of meconium, condition after birth
- Acute injury, illness, or hospitalization
- Respiratory problems
- Failure to thrive, growth delay
- Developmental delay
- Surgeries

Review of Symptoms

- Cold sensitivity, coarse hair, dry skin, fatigue, poor feeding, etc. (consider hypothyroidism)
- Cough, wheeze, dyspnea, easy fatigue (consider cystic fibrosis)
- Weakness (consider spinal cord or neuromuscular anomaly/disease)
- Daytime urinary incontinence, voiding dysfunction

Medications/Allergies/Immunizations

Family History

- GI disease: constipation, food allergy, celiac disease, HD
- Cystic fibrosis
- Thyroid, parathyroid disease
- Mood/anxiety disorder, eating disorder

CLINICAL box

99% of healthy term newborns pass meconium before 48 h of life. 50% of children with Hirschsprung disease (HD) will also pass meconium within 48 h.

IMPORTANT POINTS
ON Hx

- Onset of constipation < 1 mo of age
- Passage of meconium > 48 h
- Ribbon-like stools
- Failure to thrive or growth delay
- Bilious vomiting
- Bloody stools without evident anal fissures

Psychosocial History

- Mood/anxiety disorder, anorexia
- Peer interactions
- Temperament
- Disruption of child/family life or activities
- Social exclusion by siblings, parents, peers, teachers

Physical Exam

- General appearance, vital signs
- Dermatologic: coarse hair, dry skin, erythema nodosum, dermatitis herpetiformis
- HEENT: conjunctivitis/episcleritis, oral lesions, cheilitis/glossitis, sinusitis, lymphadenopathy, thyromegaly
- Respiratory: increased work of breathing, abnormal lung auscultatory findings

Specific focus on:

- Growth parameters: abnormal weight, length/height, BMI
- abdo: surgical scars, distension, muscle tone, fecal mass, hepatosplenomegaly
- Perianal inspection: anal position, stool present around anus or undergarments, erythema, fistula, scars, skin tags, anal fissure
- Digital rectal exam[†]: anal wink, ease of insertion of finger, anal tone, stool presence/consistency, fecal mass, mass, blood
- Lumbosacral inspection: midline anomalies, gluteal clefts
- Neurologic: cremasteric reflex, lower limb neuromotor exam

CLINICAL box

Red Flags on Physical Exam Suggestive of Organic Etiology

- Severe abdo distension
- Abnormal abdo musculature
- Abnormal anal position (e.g., anteriorly displaced)
- Perianal fistula
- Anal scars, hematomas, or extreme fear during anal inspection
- Tight, empty rectum with palpable abdo fecal mass
- Explosive stool and air from rectum after withdrawal of examining finger (“blast sign”)
- Midline pigmentary abnormalities of lower spine
- Sacral dimple and/or overlying tuft of hair
- Gluteal cleft deviation, flat buttocks
- Absent anal reflex (anal wink) or cremasteric reflex
- Decreased strength/tone/deep tendon reflexes in lower extremities

Investigations

- Not routinely indicated in absence of alarm symptoms; can diagnose functional constipation with Hx ± physical exam
- In the setting of suspected functional constipation with fecal incontinence
  - AXR: may help diagnose fecal impaction when physical exam is unreliable or not possible
- If alarm signs/symptoms suggest underlying organic etiology, laboratory and other investigations are recommended based on the DDx.
- Laboratory tests to consider may include electrolytes, calcium, TSH, T_4, celiac screen (± lead level, sweat chloride).
- Intractable constipation (constipation unresponsive to optimal conventional treatment for > 3 mo) with normal laboratory tests (including colonic transit time evaluation) → must rule out:
  - Hirschsprung Disease (HD)
    - Anorectal Manometry (ARM)—evaluates response of internal anal sphincter after rectal balloon inflation, and assesses for rectoanal inhibitory reflex (absent in HD)
    - Rectal biopsy—gold standard for Dx

[†] Recommended in presence of alarm signs or symptoms, or in patients with intractable constipation

- Anatomical malformations
  - Barium enema may be considered; however, this is not a valid alternative to rectal biopsy or ARM to exclude or diagnose HD.
- ± Cow's milk protein allergy
  - Consider 2 to 4 wk trial of cow's milk protein avoidance
  - Allergy testing is **not** routinely recommended in children with functional constipation (due to conflicting evidence that cow's milk allergy is an etiology of constipation).
- ± Spinal cord malformations/anomalies
  - MRI of spine **not** routinely supported in patients without neurologic or lumbosacral abnormalities

Treatment

- Counseling
  - Education about pathophysiology of functional constipation, with explanation that soiling is not defiant behavior
  - Reassurance—positive messaging with clear management plan
  - Guidance for toilet training (> 4 y.o.): routine scheduled toilet sitting, no punishments for not stooling during toileting time, praise and reward for stooling and behavior of toilet sitting
  - Goal: 1 to 2 soft stools/d
  - Discussion of medications and an "emergency plan" if impaction recurs
- Nonpharmacologic advice
  - Normal fiber intake, fluid intake, and physical activity are recommended.
- Pharmacologic treatment of impaction
  - First-line: high-dose oral PEG (polyethylene glycol) × 3 to 6 d
  - Second-line: rectal enema, once daily, × 3 to 6 d
- Pharmacologic treatment, maintenance therapy
  - First-line treatment: PEG (start at 0.4 g/kg/d, adjust based on response)
  - First-line treatment if PEG unavailable: lactulose (1–2 g/kg/dose, daily or b.i.d.)
  - Second-line or adjunctive treatments: osmotic laxatives (milk of magnesia), fecal softeners (milk of magnesia), and stimulant laxatives (bisacodyl, senna, sodium picosulfate)
  - Enemas are not recommended as maintenance.
  - Duration: minimum of 2 to 6 mo, with symptom resolution for minimum of 1 mo
    - Discontinuation not recommended while toilet training
    - Gradual taper recommended
- If treatment ineffective: assess for adherence, reeducate, consider untreated fecal impaction or altering maintenance therapy (adjunctive medication; change in dose of current medication)
- Referral to specialist—if concern for organic disease when there is failure of therapy (especially if fecal impaction)
- Referral to mental health provider—consider if behavioral or motivational problems are interfering with successful treatment

CLINICAL box

The Digital Rectal Examination (DRE)

Evidence does not support the routine use of DRE to diagnose functional constipation.

DRE is recommended if only one of the Rome III Criteria is present and Dx of functional constipation is uncertain.

FAILURE TO THRIVE

MCC OBJECTIVE

Based on Objective #31-2 (Failure to Thrive [Infant, Child]) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Failure to thrive is defined as weight that falls or remains below the third percentile for age; that decreases and crosses two percentile lines or is less than 80% median weight for height.
- Failure to thrive can be associated with short stature as well.

CLINICAL box

Inadequate nutritional intake is the most common etiology of failure to thrive (FTT) in primary care practice.

!

Think of FTT if a child's plotted weight crosses two or more major percentile lines on the growth chart

- Children should be plotted on the appropriate WHO growth chart, and growth should be followed closely over time.
- Premature infants should be corrected for their prematurity up to 24 mo of age

APPLIED SCIENTIFIC CONCEPT

- It is essential to differentiate normal from abnormal growth patterns to prevent long-term problems.
- Unrecognized failure to thrive (FTT) may lead to severe behavioral, medical, and developmental difficulties.
- Children with FTT may be more susceptible to severe or prolonged infections.

CAUSAL CONDITIONS

- FTT is traditionally classified as organic versus nonorganic, but now found to be multifactorial.
- Prenatal etiology:
  - Maternal: preexisting conditions (diabetes, renal disease, etc.), drugs, smoking, alcohol
  - Pregnancy: placental insufficiency, intrauterine infections
  - Genetic: chromosomal abnormalities, syndromes
- Postnatal etiology:
  - Inadequate nutritional intake
  - Inadequate absorption
  - Increased GI or urinary losses
  - Increased metabolic requirements

APPROACH (Figure 18.6)

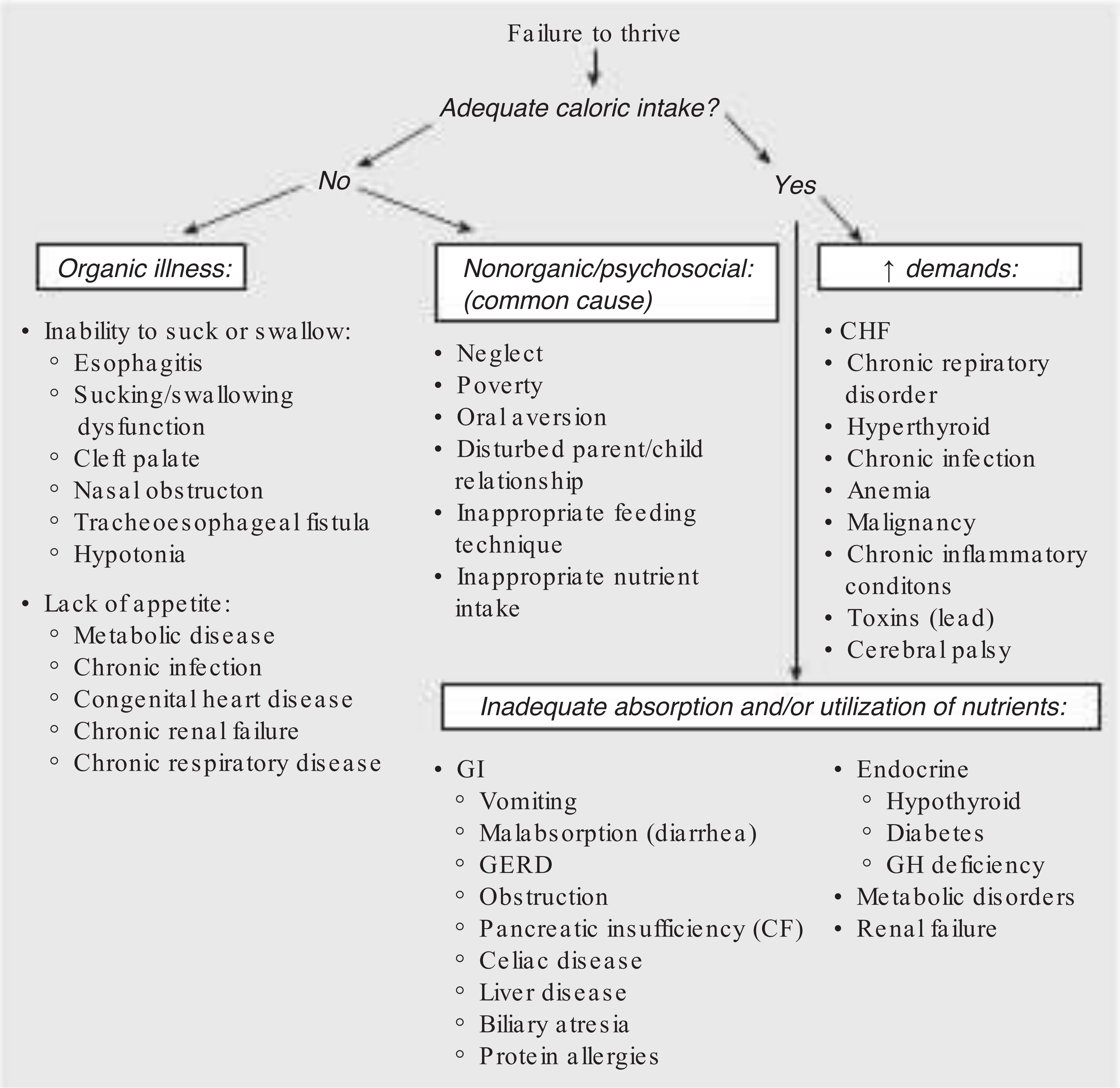


Figure 18.6. Approach to FTT.

history

- Determine onset of FTT and association with other factors
- Prenatal: maternal hypertension, drugs, smoking, infections
- Birth: lack of appropriate maternal weight gain, IUGR, positive newborn screen
- Diet: feed volumes, food/formula intolerance, accessibility to nutrition, dyspnea/tachypnea with feeds
- GI: diarrhea, vomiting, jaundice, dysphagia
- Development: social interactions, developmental delay in any domain
- Behavior: irritability, easily fatigued, colic
- Medical Hx: chronic conditions (such as cerebral palsy), organ dysfunction, chronic infections, allergies, chronic lung disease, obstructive sleep apnea, evidence of underlying genetic cause
- Family: chronic medical conditions, height/weight of family members, ethnicity
- Psychosocial: living environment, family structure, Hx of abuse or neglect, family substance abuse, violence, child-rearing beliefs, level of education

physical Exam

- Accurate measurements of a child's weight, height, and head circumference should be plotted on each visit on a standardized growth chart (WHO) (Figure 18.7).
- Observation of the child's behavior and parental interaction
- Full physical exam, with attention to:
  - General: edema, wasting, hypotonia, changes to skin and hair color and texture, dysmorphisms, mental status changes, signs of vitamin deficiency
  - Respiratory distress, cough, tonsillar hypertrophy
  - Heart murmurs
  - Hepatomegaly, abdo distension

Investigations

- Pre/perinatal causes
  - TORCH screen, HIV if appropriate
  - Genetics consultation; chromosomal and molecular genetic testing
  - Cranial U/S
- Feeding issues
  - Three-day dietary record

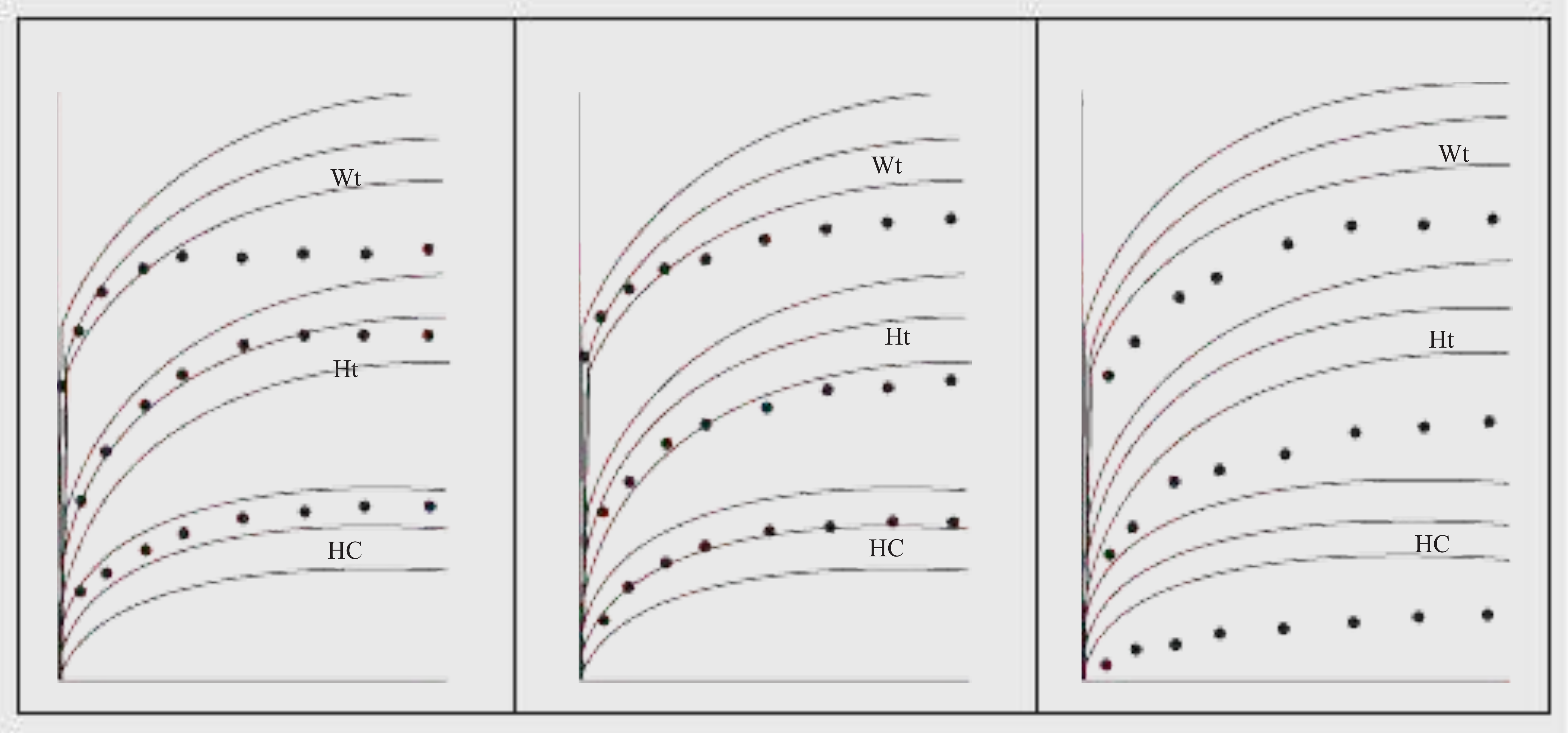


Figure 18.7. Interpreting growth parameters.

  - Lactation consultation (infants: latch, suck, swallow)
  - Dietitian and OT-observed feeds
- Malabsorption/utilization
  - CBC, differential
  - Protein, albumin, bilirubin, liver function tests, coagulation factors (INR)
  - Iron, ferritin
  - Inflammatory markers (ESR, CRP)
  - Anti-TTG, IgA
  - Stool for lipid globules, reducing substances
  - Sweat chloride, Sao$_2$, sleep study
  - Upper GI series (imaging)
- Increased demands
  - Metabolic: metabolic screen, serum and urine amino acids, molecular genetic testing
  - Renal failure: urinalysis, creatinine, electrolytes
  - Infections: HIV/other viral serology, stool cultures, immunoglobulins
  - Congenital heart disease: associated clinical findings and cardiac imaging
  - Respiratory: sweat chloride
  - Endocrine: low TSH, high FT$_4$, glucose, insulin tolerance test (for GH deficiency), bone age

Diagnosis

- A thorough clinical Hx and physical exam, as well as properly plotted growth parameters on a standardized chart, are the most helpful factors in the Dx of FTT (Table 18.25).
- There are no gold standard tests or imaging for FTT.
- The degree of investigations, for laboratory and diagnostic imaging, should be guided by the Hx and clinical suspicion for different etiologies.
- FTT by itself is not a Dx, but rather points to an underlying problem.

Management

- Multidisciplinary approach (such as dietitian, PT, OT, etc.) to managing the underlying cause of the child's FTT
- Consultation of subspecialists, as needed (e.g., metabolic specialists, neurologists, gastroenterologists)
- Continue management of any existing comorbidities
- Counseling and education
- Connect with community resources

TABLE 18.25 • Interpreting growth parameters

Patterns	I	II	III
Head circumference	Normal	Normal	↓
Height	Normal or ↓	↓	↓
Weight	↓, Low for height	↓, Proportional to height	↓, Proportional to height
Appearance	Malnourished	Healthy	Stunted
Growth chart		See Figure 18.7	
Etiologies	See Figure 18.6	Endocrinopathy Dwarfism Constitutional deprivation Normal variant short stature (not true FTT)	Early onset FTT: • IUGR • Chromosomal/ genetic abnormality • Perinatal insults

CLINICAL box

Social/Psychological Impact of FTT

FTT can lead to learning problems in school, behavioral disturbances, and mental retardation.

CHILD WITH PAIN AND LIMP

MCC OBJECTIVE

Based on Objective #20 (Limp in Children) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Limp: uneven or jerky walk, due to pain, weakness, or deformity
- Limp is usually due to benign conditions (such as transient synovitis), but may be life or limb threatening.
- Epidemiology: approximately 2/1,000, M > F, pain in hip > knee > leg

APPLIED SCIENTIFIC CONCEPT

- Limp can be caused by pain, weakness, or structural abnormalities of the bones, joints, soft tissues, or nerves of the lower extremities, pelvis, or spine.
- **Synovial membrane:** inner tissue layer lining a joint, which secretes synovial fluid to lubricate the joint
  - This fluid can become inflamed or infected and cause symptoms of pain and swelling.
- **Transient synovitis:** self-limiting, nonspecific inflammation of the synovial membrane
  - The most common cause of pediatric nontraumatic hip pain
- The Dx of **septic arthritis** must be ruled out (with synovial fluid analysis and cultures).
  - Delayed Dx and treatment are associated with increased morbidity.

CAUSAL CONDITIONS

- Etiology of limp can be classified by the location of the abnormality (Table 18.26).

TABLE 18.26 • Child with limp/pain: Causal conditions by location

etiology	examples
Bones (osseous)	Fractures (Salter-Harris, Toddler's, stress, abuse) Apophysitis (bony outgrowths; Osgood-Schlatter) Vasoocclusive crisis in sickle cell disease Legg-Calve-Perthes disease Slipped capital femoral epiphysis Tumors
Joints (articular)	Transient synovitis Septic arthritis Osteomyelitis Juvenile idiopathic arthritis HSP Serum sickness Systemic lupus erythematosis
Soft tissue	Contusion Muscle strain Sprain Tendonitis Cellulitis Abscess
Neurologic	Peripheral neuropathy Complex regional pain syndrome Cerebral palsy Meningitis
Other	Conversion disorder Growing pains

!

Think of septic arthritis in a child with limp who is febrile and toxic appearing

CLINICAL box

Be aware of referred pain. Knee pain can be attributed to a hip pathology.

CLINICAL box

growing pains present as recurrent, self-limited, and usually bilateral leg pain; common in preschool- and school-aged children

!

Always think of and rule out child abuse

- Limp and pain can also be grouped by age and duration of symptoms; for example:
  - All age-groups: infection, trauma (fractures, soft tissue injury)
  - Preschool aged: DDH
  - School aged: Legg-Calve-Perthes disease, leukemia, osteosarcoma
  - Adolescents: Osgood-Schlatter disease, slipped capital femoral epiphysis, overuse injuries

APPROACH

History

- Limp and pain → duration, quality, relieving and provoking factors
- Fever, red, hot swollen joint → rule out septic joint
- Recent viral/streptococcal infection → postinfectious arthritis
- Constitutional symptoms → malignancies
- Hx of trauma → fractures, soft tissue injuries, nonaccidental injuries
- New or ↑ sports and activity → stress fractures
- Endocrine dysfunction, obesity → slipped capital femoral epiphysis
- Morning stiffness → juvenile idiopathic arthritis
- Back pain → discitis, meningitis, vertebral osteomyelitis
- Current and past medical conditions, age and sex of the child
- FHx of connective tissue diseases, autoimmune conditions
- Child abuse

Physical Exam

- Vitals: look for signs of sepsis (fever, hypotension, tachycardia, change in mental status)
- Full physical exam, focused on the MSK system (including spine, hips, lower extremities)
- Inspection: deformities, joint effusions, erythema, asymmetry, rashes
- Palpation: location of pain (joint or soft tissue), bony deformities
- ROM: active and passive
- Special tests: Trendelenburg test, Barlow, Ortolani
- Measure leg length discrepancy (> 1.25 cm), assess gait, ability to weight bare
- Neurologic exam: CNS, PNS, strength, reflexes, myotomes, dermatomes

Investigations

- X-ray imaging: first-line imaging in a child with limp
- U/S: DDH in < 3 mo, small joint effusions, U/S-guided joint aspiration
- CT/MRI: in special cases (osteomyelitis, spine pathologies, malignancy)
- Blood work: CBC, ESR, C-reactive protein; blood cultures if sepsis suspected
- Synovial fluid analysis: for inflammatory and infectious conditions

Diagnosis

- Limp etiology is usually diagnosed through Hx, physical exam, and radiographic imaging; diagnostic procedures are not routinely indicated.

Management

- Initial management: well- versus ill-appearing child, vital signs
- Focused and thorough Hx and physical exam
- Imaging as needed: initial x-ray, and then additional imaging and laboratory tests as guided by the clinical exam
- For the toxic or hemodynamically unstable child: IV fluids, blood work (including cultures), joint aspiration for synovial fluid analysis, IV antibiotics, consult orthopedics, may require surgery (for a septic joint)

DEVELOPMENTAL DELAY

MCC OBJECTIVE

Based on Objective #21 (Developmental Delay) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- **Developmental delay:** a chronological delay in the appearance of set developmental milestones achieved during infancy and early childhood. Causes include organic, psychological, and environmental factors, though the cause of a child's developmental lag is often unknown.
- **Global Developmental Delay (GDD):** developmental delay in > 2 areas during infancy or preschool years

APPLIED SCIENTIFIC CONCEPT (Table 18.27)

TABLE 18.27 • Developmental milestones

Age	Gross Motor	Fine Motor	Language	Social
Newborn	Raises head slightly, hands fisted, primitive reflexes	Tight grasp, follows to midline	Alerts to sound	Regards face, responds positively to feeding
2–3 mo	Holds head in midline, lifts chest, supports on forearms	Tracks past midline, waves at toys	Searches for sound with eyes, coos	Recognizes parents, social smile, moves arms actively to stimulus, anticipates feeds
4–5 mo	Rolls front-back/back-front, sits when propped, supports on wrists	Moves arms in unison to grasp objects	Orients to voice, makes razzing sounds	Hand regard, enjoys looking at environment, reaches out for toys, laughs
6–8 mo	Sits unsupported, feet to mouth while supine	Reaches with one hand, transfers, raking grasp	Babbles, responds to name, indiscriminant dada/mama	Recognizes strangers, looks toward person talking to them
8–12 mo	Creeps, crawls, cruises, pulls to stand	Pincer grasp, probes with forefinger, holds bottle	Understands "no," waves, discriminant dada/mama	Explores environment, object permanence
12–18 mo	Walks alone, creeps upstairs	Throws objects, scribbles in imitation, builds two- to four-block tower	Uses two words, runs, unintelligible words together	Imitates, comes when called, cooperates with dressing, indicates wants
18–24 mo	Runs, throws toys, kicks balls, walks upstairs	Turns 2 pages at a time, spoon feeds self, builds four- to six-block tower	Knows 8 body parts, uses intelligible words in jargoning, > 20 words	Copies tasks, plays alongside other children, seeks approval
2–3 yr	Walks up + down stairs, overhand throw	Turns pages one at a time, removes clothes, holds pencil	> 50 words and 2-word sentences, 25% intelligible	Parallel play, imaginary play, gender aware
3 yr	Pedals tricycle, alternates feet up stairs	Dresses and undresses partially, copies circle	3-word sentences, minimum 250 words, knows own name, 75% intelligible	Group play, shares toys
4 yr	Hops, skips	Buttons, catches ball, copies square	Colors, asks questions, prints first name	Tells tales, plays cooperatively
5 yr	Skips alternating feet, jumps over obstacles	Ties shoes, copies triangle	Prints first name	Plays competitive games, follows rules

CAUSAL CONDITIONS

- Global developmental delay
  - Neurologic disorders (e.g., cerebral dysgenesis, fetal alcohol syndrome)
  - Genetic and metabolic disorders (e.g., trisomies, aneuploidies, storage disorders)
  - Toxic exposures (e.g., TORCH infections, lead poisoning)
  - Severe psychosocial deprivation (e.g., emotional neglect, sexual or physical abuse)
- Speech and language delay
  - Hearing impairment (e.g., conductive or sensorineural hearing loss)
  - Autism spectrum disorders

  - Developmental language disorder (e.g., problems of articulation, fluency, resonance)
- Motor delay
  - Cerebral palsy
  - Muscular dystrophies
  - Developmental coordination disorder

AppROACh

history

- A complete pediatric medical Hx is key, with focus on:
  - Prenatal: maternal illness, infectious exposures, substance use/medications, previous (or recurrent) miscarriages/stillbirth, Hx of SIDS
  - Perinatal: obstetrical complications, prematurity, low BW, multiple gestation, neurologic events (sepsis, meningitis, hypoxia), kernicterus, hypoglycemia
  - Postnatal: recurrent otitis media, poor feeding/growth, toxic exposures, head injury, meningitis
- **FHx:** consanguinity, developmental delay/learning disabilities, genetic/metabolic disorders, deafness/blindness, ASD, seizures, psychiatric conditions
- **SHx:** home environment, maternal social demographics, school/day care program, access to special services/rehabilitation/respite, family violence, financial/social support, Hx of neglect or sexual abuse
- **Determine major milestones:** when were they first reached; current level of function, any signs of regression:
  - **Gross motor** (e.g., timing of sitting, crawling, walking, running, stairs, tricycle)
  - **Fine motor** (e.g., transferring, pincer grasp, buttons, use of scissors, cups)
  - **Language** (e.g., vocabulary, expressive/receptive language, articulation, fluency, languages spoken at home, reading abilities)
  - **Social:** eye contact, nonverbal communication, aggressive/maladaptive or self-injurious behaviors, interest in peers, ability to play by self and with others

physical Exam (Table 18.28)

- Growth parameters: percentiles for height, weight, and head circumference
- Complete general physical and neurologic exam
- Accurate description of dysmorphic features

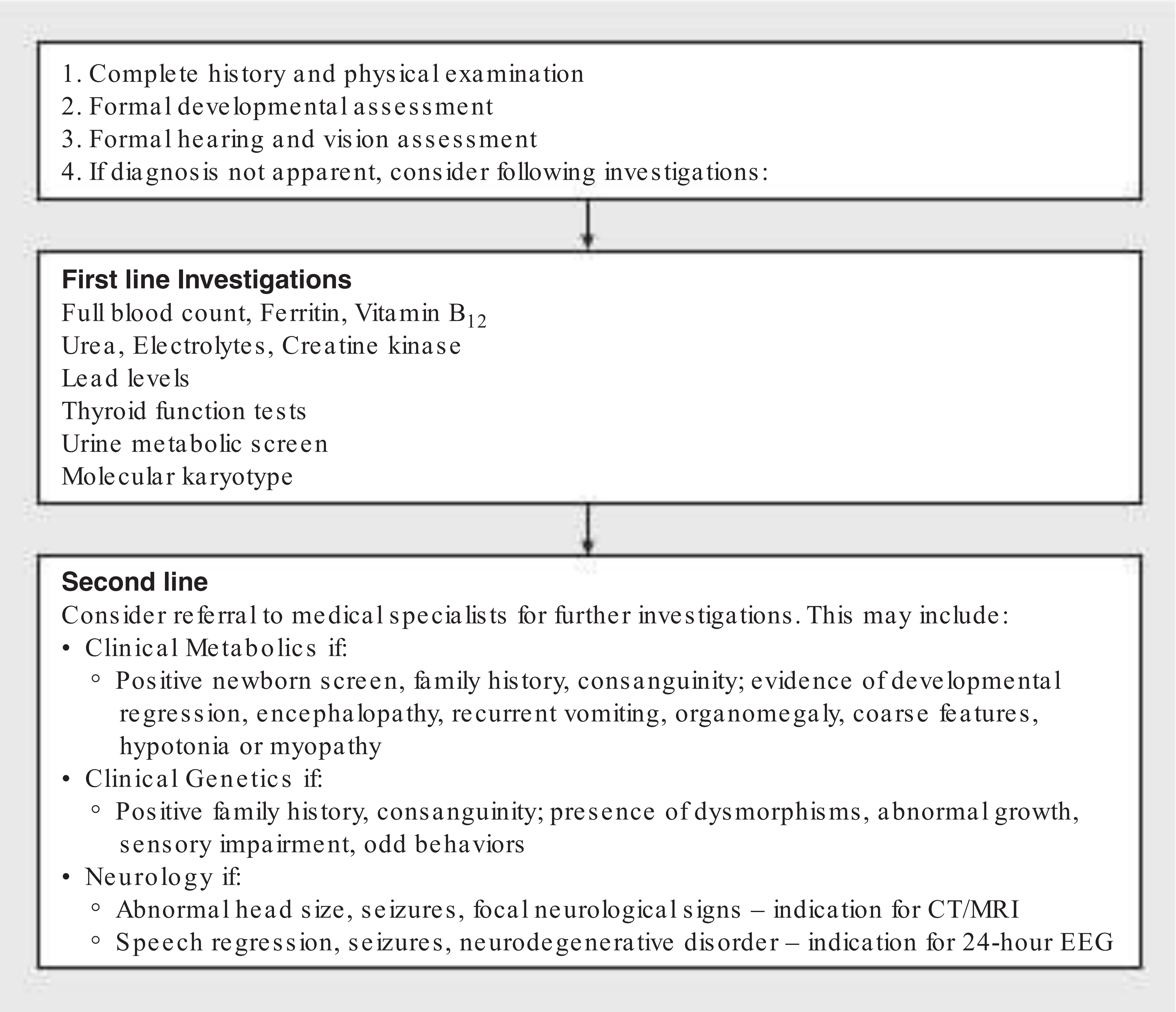
TABLE 18.28 • Dysmorphic features indicating potential cause of developmental delay

Item	Possible Significance
Short stature	Malnutrition, Williams syndrome, Turner syndrome
Obesity	Prader-Willi syndrome
Microcephaly/macrocephaly	Micro: any condition retarding brain growth
	Macro: Sotos syndrome, hydrocephalus, mucopolysaccharidoses
Facial dysmorphism	Fetal alcohol syndrome, trisomies, cri du chat
Skin lesions (café au lait spots, Shagreen patches, port-wine stains)	Neurofibromatosis, tuberous sclerosis, Sturge-Weber syndrome
Abnormal tone/ataxia	Hypertonic: cerebral palsy, neurodegenerative
	Hypotonic: Prader-Willi, Down, Angelman syndromes
Joint contractures (sign of muscle imbalance around joints)	Arthrogryposis cerebral palsy, muscular dystrophy
Size of genitalia	Macro-orchidism = Fragile X syndrome; hypogenitalism = Prader-Willi/Klinefelter syndrome, CHARGE association

- Neurodevelopmental assessment: observe child in play room and corroborate Hx with major developmental milestones

Investigations (Figure 18.8)

- Functional vision and hearing assessment
- Obtain specific tests or cytogenetic screen if patient has a close family member with GDD



1. Complete history and physical examination
2. Formal developmental assessment
3. Formal hearing and vision assessment
4. If diagnosis not apparent, consider following investigations:

First line Investigations

Full blood count, Ferritin, Vitamin B_{12}
Urea, Electrolytes, Creatine kinase
Lead levels
Thyroid function tests
Urine metabolic screen
Molecular karyotype

Second line

Consider referral to medical specialists for further investigations. This may include:

- Clinical Metabolics if:
  - Positive newborn screen, family history, consanguinity; evidence of developmental regression, encephalopathy, recurrent vomiting, organomegaly, coarse features, hypotonia or myopathy
- Clinical Genetics if:
  - Positive family history, consanguinity; presence of dysmorphisms, abnormal growth, sensory impairment, odd behaviors
- Neurology if:
  - Abnormal head size, seizures, focal neurological signs – indication for CT/MRI
  - Speech regression, seizures, neurodegenerative disorder – indication for 24-hour EEG

Figure 18.8. Investigating GDD of unclear etiology.

- Neuromuscular testing (e.g., EMG, muscle biopsy, EEG) in cases of suspected muscular dystrophies, epileptic disorders
- Consider thyroid and urine metabolic screen
- Consider screening for autism, language disorders, and learning disabilities
- Limited role for neuroimaging, but may play an important diagnostic role in the presence of neurologic signs or symptoms, seizures, developmental regression, microcephaly, nonfamilial macrocephaly, and congenital malformations
  - MRI is indicated in patients with structural abnormalities, Hx of perinatal injury or regression, and for the evaluation of neuronal migration and myelination disorders
  - CT is reserved for suspected craniosynostosis, intracranial calcifications
- Clinical genetics referral in cases of dysmorphism, GDD and ASD for chromosomal/DNA analysis, microarray

Diagnosis

- Often difficult to make, and requires a multidisciplinary approach
- All failed developmental screening tests require a detailed and comprehensive evaluation.

Management

- Family counseling
  - Facilitate clarification, provide reassurance
  - Education + specific parenting advice

  - Suggest environmental interventions based on needs
  - Support patient problem solving
  - Facilitate/interpret referrals
  - Provide links to resources
- Educational support
  - Early-childhood education
  - Individualized educational plan
  - Psychological interventions as appropriate (e.g., behavior management techniques)
- Speech/language
  - Speech therapy
  - Amplification devices
  - Educational modification
  - Family support
- Medical
  - Motor: physiotherapy/occupational therapy, seizure control, antispasmodics
  - Diet: chart weight/height, vitamin supplementation, ketogenic diet for seizures
  - Sensory: audiologist, ophthalmologist
  - Behavior: sleep, aggression; psychotropic drug levels
  - Infectious diseases (e.g., aspiration pneumonia), immunizations
  - Sexuality (e.g., education, hygiene)
  - Dermatology (e.g., prevention of decubitus ulcers and infections)

CLINICAL box

Risk factors for Speech/Language Delay

- *Family/environmental:* FHx of hearing or speech/language problems or cognitive limitation, children in foster care, FHx of child maltreatment
- *genetic/congenital:* prenatal complications, prematurity, microcephaly, teratogen exposure, FAS, genetic disorders, dysmorphic features, positive toxicology screen at birth
- *Medical conditions:* ear/hearing problems, oral motor/feeding problems, cleft lip/palate, tracheotomy, autism, FTT, ototoxic drugs, recurrent otitis/mastoiditis

Manager: Community Support Services and Resource Allocation

- Management of patients with developmental disorders is resource intensive; some will have extremely high needs.
- Resources may be limited, but need to be made available to families in a manner that is fair and equitable, without bias or discrimination
- Would benefit from improved government funding; advocacy for improvement in funding needs can be initiated at many levels

SEIZURES IN CHILDHOOD

MCC OBJECTIVE

Based on Objective #92 (Seizures/Epilepsy) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- **Seizure:** transient clinical expression of abnormal, excessive, synchronous discharges of cortical neurons
- **Epilepsy:** chronic disorder characterized by recurrent seizure episodes that are unprovoked in nature; may be due to syndromes or be cryptogenic in nature
- **Status epilepticus:** ongoing seizure activity for > 30 min **or** repetitive seizure activity without return of consciousness for > 30 min

APPLIED SCIENTIFIC CONCEPT

- Seizures may occur as an isolated event, be triggered by a transient disruption of cortical neuronal function, or be a manifestation of a chronic neuronal disturbance.
- Ischemic and excitotoxic neuronal cell loss may commence after 30 min of seizure activity.
- Seizures that last longer than 5 to 10 min are at high risk of continuing for at least 30 min; therefore, early treatment of impending status epilepticus is recommended.

CAUSAL CONDITIONS

- Nonepileptiform:
  - Syncope: transient loss of consciousness; usually vasovagal. May be associated with brief myoclonic jerks. Rapid return to baseline. More common in adolescent females
  - Breath-holding spell: child stops breathing at end expiration after crying episode. Typically because of pain or anger, which leads to enhanced vagal responses. Lasts < 1 min. May result in syncope, rarely seizures.
  - Migraines: variants of acute confusional migraine or benign paroxysmal vertigo may resemble seizures.
  - GERD: Sandifer syndrome (esophagitis leading to back arching, neck turning that may resemble posturing. Child irritable, but no loss of consciousness)
  - Psychogenic nonepileptic seizures (aka. pseudoseizures): emotional or stress-related in origin, usually involuntary, onset in early childhood very uncommon. Does not respond to antiepileptic drugs.

    - Suggestive motor features: side-to-side head shaking, bilateral asynchronous movements, stuttering, and arching of the back, thrashing limbs, forceful eye closure, pelvic thrusting
- Provoked seizures
  - Febrile
    - Benign seizures occurring in children between 6 mo and 6 yr of age, associated with a temperature > 38°C. Seizures are not the result of a CNS infection/metabolic disturbance, and occur without a prior Hx of afebrile seizures.
  - Intercurrent illness
  - Metabolic derangements/withdrawal
  - Hemorrhagic/ischemic stroke
- Unprovoked seizures
  - Idiopathic
  - Symptomatic
  - Cryptogenic

See Table 18.29 for seizure classification.

TABLE 18.29 • Seizure classification

Seizure type	Clinical Features
Generalized—Initial Activation of Neurons Involve Both Hemispheres	
Generalized Tonic-Clonic (GTC)	Most common; stiff limbs for 10–30 sec, then rapid jerking of limbs + trunk
Tonic	Sustained muscle contraction, high-pitched cry, < 60 sec
Clonic	Rhythmic, symmetrical contractions of groups of muscles; prolonged
Atonic	Sudden loss of muscle tone; < 1–2 sec
Myoclonic	Sudden, brief (< 100 msec) involuntary muscle contractions; generalized or focal; single or repetitive; rhythmic or irregular
Absence (staring spells)	Abrupt cessation of activity with maintenance of tone; < 30 sec; no postictal state
Partial—Initial Activation of Neurons Limited to Part of One Hemisphere	
Simple motor	Activation of cerebral cortex, may see Jacksonian march; tongue, lips, hands commonly involved
Simple sensory	Activation of sensory cortex; numbness or dysesthesias in any body part; abnormal proprioception
Simple autonomic	Activation of central autonomic network; epigastric sensation, sweating, dilated pupils
Complex partial	Any of the above partial seizure subtypes + LOC
Febrile—Benign Seizures Precipitated by Rapid 1 High Fever	
Typical	GTC lasting < 15 min, solo event in 24 h, normal development and normal neurologic exam
Atypical	Generalized seizure lasting > 15 min, focal feature or postictal paresis; occurring in series with total duration > 30 min

Note: Simple—no alteration in LOC/Complex—alteration in LOC.

APPROACH

History

- First seizure, age of onset
- Details of seizure manifestations
  - Preictal
    - Events surrounding episode

CLINICAL box

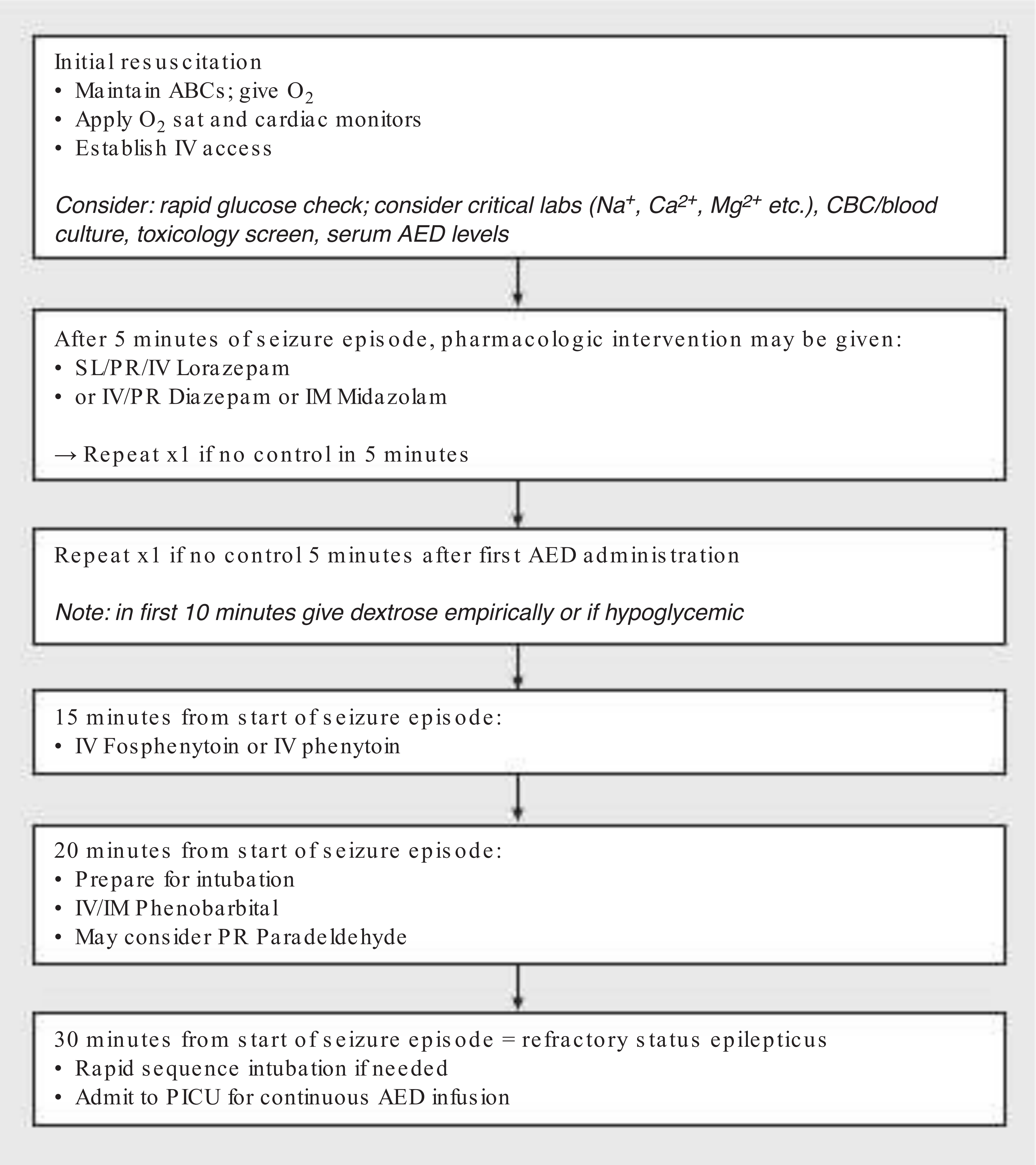
Features Suggestive of Seizure

Aura, identifiable triggers, altered breathing, cyanosis, incontinence, tongue-biting, prolonged postictal drowsiness, confusion amnesia, transient focal paralysis (Todd's)

        - Triggers (PMHx, fever, trauma, ingestion, flickering lights)
        - Prodrome (change in mood/behavior noticed by patient or parent)
        - Aura (epigastric feeling, déjà vu, strange smell, flashing lights)
    - Interictal
        - Description and duration of episode (focal features, motor events, automatisms/vocalizations)
    - Postictal
        - Headache, confusion, fatigue/sleep, myalgia, tongue-biting, incontinence
        - Mental status, lingering focal neurologic signs
    - Review of systems:
        - Headache, vomiting, visual alterations, weight loss, change in behavior
- Developmental Hx
- FHx of epilepsy or other neurologic disorders

physical Exam (Figure 18.9)

- Vital signs 1 ABCs (support airway if needed)



Initial resuscitation
- Maintain ABCs; give O_2
- Apply O_2 sat and cardiac monitors
- Establish IV access

Consider: rapid glucose check; consider critical labs (Na^+, Ca^{2+}, Mg^{2+} etc.), CBC/blood culture, toxicology screen, serum AED levels

After 5 minutes of seizure episode, pharmacologic intervention may be given:
- SL/PR/IV Lorazepam
- or IV/PR Diazepam or IM Midazolam

→ Repeat x1 if no control in 5 minutes

Repeat x1 if no control 5 minutes after first AED administration

Note: in first 10 minutes give dextrose empirically or if hypoglycemic

15 minutes from start of seizure episode:
- IV Fosphenytoin or IV phenytoin

20 minutes from start of seizure episode:
- Prepare for intubation
- IV/IM Phenobarbital
- May consider PR Paradeldehyde

30 minutes from start of seizure episode = refractory status epilepticus
- Rapid sequence intubation if needed
- Admit to PICU for continuous AED infusion

Figure 18.9. Approach to status epilepticus.

- Glasgow Coma Scale, Mental Status Exam
- Full neurologic exam, including: dysmorphisms, fontanelle, head circumference
- Signs of meningismus (neck stiffness, Kernig/Brudzinski signs, fundoscopic exam)
- Abdo exam (e.g., storage diseases)

- Dermatologic exam (e.g., meningitis, neurocutaneous syndromes)
- Look for signs of head trauma, abuse, intoxication

Investigations

- Laboratory tests should be based on individual Hx and clinical findings—was seizure provoked or unprovoked? (e.g., dehydration, vomiting, diarrhea, ingestion)
  - CBC, differential, glucose, electrolytes, calcium, magnesium, urea, creatinine, blood gas, toxicology screen
- Lumbar puncture: if meningitis or encephalitis is suspected
- ECG/Holter monitor: if etiology unclear or cardiac symptoms present
- EEG: acutely if not recovering or as an outpatient if first unprovoked seizure (e.g., organic cause or epilepsy suspected)
- Neuroimaging
  - MRI is the preferred modality, but there is insufficient evidence for routine use.
    - Emergent neuroimaging may be used if a child exhibits persistent postictal focal deficits.
    - Nonurgent neuroimaging should be considered in children with a significant cognitive/motor impairment of unknown etiology, unexplained deficits on neurologic exam, seizures of focal onset, or in children < 1 yr of age

Diagnosis

Based on a thorough Hx and physical exam, in conjunction with investigations

Management

- Febrile seizure:
  - Counseling (e.g., risk of recurrence, risk of epilepsy, how to manage future seizures, emotional support)
  - Buccal midazolam or rectal diazepam may be provided to parents for treatment of future seizure episodes.
- First unprovoked seizure:
  - Counseling (as above, also: driving and swimming restrictions, safety awareness)
  - Treatment with AEDs is individualized and is dependent on risk of recurrence and results of prior investigations.
- Epilepsy:
  - Counseling
  - Treatment with AEDs is often started if patient has an abnormal EEG, MRI, development, neurologic exam, or a positive FHx.
  - Treatment goal: balance seizure control with potential drug toxicity; monotherapy where possible (see Table 18.30 for recommended AEDs)

TABLE 18.30 • Recommended AED by seizure type/epilepsy syndrome

Focal (partial) seizures	Carbamazepine, Oxcarbazepine
Generalized seizures	Valproate
Childhood absence epilepsy	Ethosuximide, valproic acid
Juvenile myoclonic epilepsy	Valproate, Lamotrigine
Infantile spasms	Vigabatrin, ACTH
Unclassified epilepsy	Valproate

  - Long-term management includes:
    - Ketogenic diet: for seizures refractory to AEDs
    - Surgery

HYPERTENSION IN CHILDHOOD

MCC OBJECTIVE

Based on Objective #9-1-1 (Hypertension in Childhood) of *Objectives for the Qualifying Examination*, 3rd edition.

A child who is overweight or obese has a significantly increased risk (2–3×) of developing primary hypertension.

OVERVIEW

- Hypertension in childhood, unlike in adults, is frequently secondary to an underlying renal pathology (renal anomalies, parenchymal disease, vascular abnormalities).
- However, primary (or essential) hypertension must still be considered, as the prevalence of hypertension is increasing, with the increasing rates of childhood obesity.
- Screening can prevent the significant morbidity and mortality associated with undetected high blood pressure.
- The normal ranges for blood pressure in children and adolescents account for age, height, and gender.
- Hypertension is defined as a sustained elevation (on three separate occasions) of the SBP or DBP ≥ 95th percentile for their age, height, and gender.
- Prehypertension is defined as SBP or DBP between the 90th and 95th percentiles.

APPLIED SCIENTIFIC CONCEPT

- Blood pressure = cardiac output × total peripheral resistance
- Renin is secreted by the juxtaglomerular cells into the circulation, resulting in conversion of angiotensinogen to angiotensin I. Angiotensin I is converted by ACE to angiotensin II. Angiotensin II results in vasoconstriction of blood vessels (↑ BP) and release of aldosterone (↑ sodium and water absorption).
- Mild changes in blood pressure do not usually lead to end organ effects, as autoregulatory mechanisms can maintain adequate organ perfusion.
- Elevated blood pressures (beyond autoregulatory levels) can result in vascular damage, resulting in release of vasoconstrictors and oxidants—resulting in ongoing tissue damage and inadequate organ perfusion.

CHOOSING THE CORRECT SIZE BP CUFF

The most common reason for an artificially elevated BP is a cuff that is too small. The inflatable bladder of the cuff should have the following characteristics:

Length—> 80% of the circumference of the mid-upper arm

Width—> 40% of the circumference of the mid-upper arm

CAUSAL CONDITIONS (Table 18.31)

TABLE 18.31 • Causes of hypertension by age

0–1 yr	1–10 yr	. 10 yr
• Congenital renal and genitourinary abnormalities • Renal—parenchymal, renovascular (renal artery thrombosis) • Aortic coarctation • Bronchopulmonary dysplasia • Neurologic (intraventricular hemorrhage) • Endocrine (CAH, hyperthyroid, etc.) • Malignancy (neuroblastoma, Wilms)	• Renal—congenital, parenchymal, renovascular (renal artery stenosis) • Reflux nephropathy • Aortic coarctation • Endocrine • Malignancy • Primary (15%–30%)	• Primary (>85%) • Same as 1–10 yr

Risk Factors for Hypertension in Childhood

General
- Prematurity
- Low BW

Renal
- Known renal disease
- Genitourinary system abnormalities
- Recurrent urinary tract infections
- FHx of renal disease—polycystic kidney disease (PKD)

Other
- Underlying chronic medical condition (i.e., endocrine conditions—diabetes, hyperthyroid, Cushing syndrome; congenital heart disease, malignancy, autoimmune disease—systemic lupus erythematosis, etc.)
- Syndromic (Turner's—associated with coarctation, renal anomalies)
- Iatrogenic (certain medications can increase blood pressure, i.e., corticosteroids)

AppROACh

history

- ID: age, gender, ethnicity
- Review of systems: headaches, fatigues, blurred vision, epistaxis, diaphoresis, dyspnea, chest pain, palpitations, flushing, secondary sexual characteristics (CAH), swollen joints (autoimmune), edema, rashes, weight loss, dysuria, hematuria (coke- or tea-colored urine), flank pain, secondary enuresis
- PMHx: take thorough Hx from pregnancy onward (NICU stay, if any lines were placed) focusing on any chronic medical conditions, hospitalizations, medication use (steroids, OCP, sympathomimetics, previous antihypertensives, herbal supplements). Must ask about Hx of recurrent UTIs, unexplained fevers treated with antibiotics in infancy
- SHx: substance use, diet (salt intake), exercise
- FHx: ethnicity, FHx of hypertension or renal disease

physical Exam

- Vitals: perform BP measurement in all children 3 yr of age and older, and check BP table for gender, age, and height to ensure within normal range
  - Children < 3 yr of age should have BP measured if they have risk factors for developing hypertension (see Causal Conditions, above).
  - 4-limb BP: UE BP > LE BP (coarctation of aorta)
- Anthropometrics: plot height and weight on WHO growth chart
- General inspection: body habitus, mood faces, tanner staging
- HEENT: papilledema, exophthalmos, thyroid (masses or goiter), tonsillar hypertrophy (OSA)
- CVS: check for brachial (or radial) to femoral delay, or decreased strength of lower extremity pulses (coarctation of aorta), listen for normal heart sounds (S_4—can be indicator of long-standing hypertension)
- Respiratory: increased work of breathing, adventitious sounds (crackles at bases)
- Abdo: ballot the kidneys and palpate for masses (may be able to feel large masses bilaterally in PKD), hepatomegaly, auscultate for bruits (RAS)
- MSK: erythematous swollen joints, pretibial edema
- Skin: café au lait macules, neurofibromas, Lisch nodules (neurofibromatosis—associated with renal artery stenosis, coarctation of the aorta), malar rash (SLE)

Investigations

- Laboratory: CBC, electrolytes, BUN, creatinine
  - Consider steroid levels, metanephrines
- Fasting labs: lipid levels, glucose
- Urine: urinalysis (R+ M, C+ S), pregnancy test in postmenarchal females
  - Consider urine toxicology screen if suspect illicit drug use
- Imaging: abdo U/S may reveal structural anomalies of the kidneys, renal vasculature, or genitourinary system.
  - Consider CXR, ECHO (cardiac abnormalities, LVH)
- Consider a sleep study, if suspect OSA
  - ABPM for 24 h (during both waking and sleeping hours) can be used in older children (> 5 yr) or teens where white coat hypertension is considered or intermittent hypertension is noted.

Diagnosis

Based on findings on Hx, physical exam, and investigations

Management (Figure 18.10)

- **Nonpharmacologic**: weight loss for obesity-related HTN, increase aerobic exercise (at least 1 h, 5× a week), decrease screen time/sedentary activities, dietary modification (salt restriction, low-fat diet, eliminate sweetened beverages), smoking cessation, decrease alcohol intake
- **Pharmacologic**: consider if patient asymptomatic (no end organ damage—no LVH, no retinal changes, etc.) and hypertension persists × 6 mo, despite implementing lifestyle and dietary changes
  - ACEI is recommended for children with DM and microalbuminuria or proteinuric renal disease.
  - First-line options: ACEI, calcium channel blockers, b-blockers, diuretics, ARBs

!

Hypertension is usually asymptomatic—therefore, it is important to screen for risk factors on Hx (see Causal Conditions, above)

CLINICAL box

When to Think of pheochromocytoma

Classic triad: episodic headaches, diaphoresis, palpitations

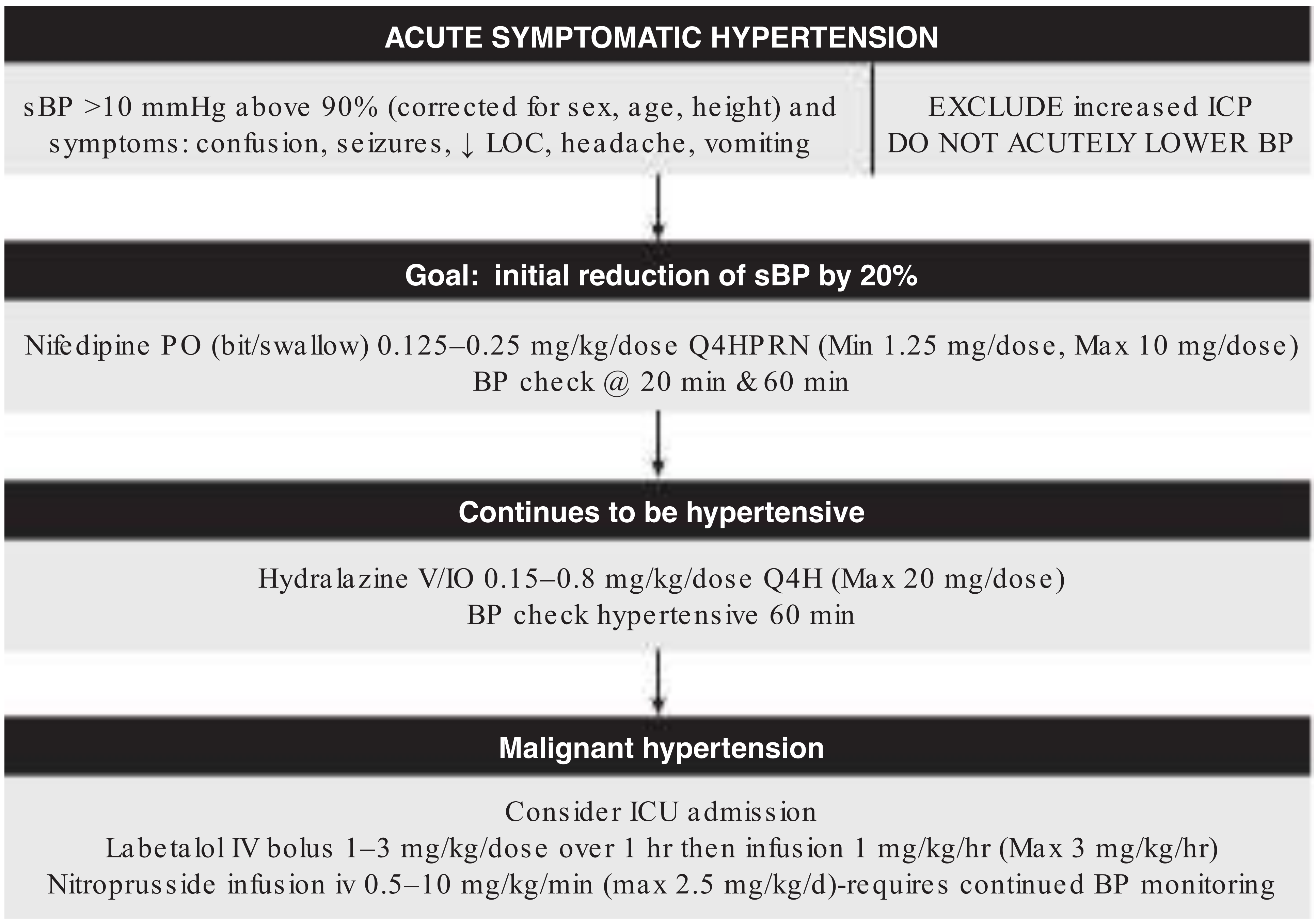
CLINICAL box

Measuring a Blood Pressure

- Choose the correct size cuff (see Red Flag Box)
- The patient should be seated, with their back, arm, and feet supported, with their antecubital fossa at the level of the heart (× 5 min)
- Inflate the cuff to find the palpable SBP (where the radial pulse disappears)—deflate the cuff
- Inflate the cuff again, auscultate, and inflate to the palpable SBP + 30 mm Hg
- Deflate the cuff slowly (2–3 mm Hg/sec)
- SBP = at the first Korotkoff sound
- DBP = when the last Korotkoff sound is heard

!

Any child found to be hypertensive must undergo further evaluation to investigate for secondary causes. Never assume that a child or adolescent has primary hypertension.



ACUTE SYMPTOMATIC HYPERTENSION

sBP >10 mmHg above 90% (corrected for sex, age, height) and symptoms: confusion, seizures, ↓ LOC, headache, vomiting

EXCLUDE increased ICP
DO NOT ACUTELY LOWER BP

Goal: initial reduction of sBP by 20%

Nifedipine PO (bit/swallow) 0.125–0.25 mg/kg/dose Q4HPRN (Min 1.25 mg/dose, Max 10 mg/dose)
BP check @ 20 min & 60 min

Continues to be hypertensive

Hydralazine V/IO 0.15–0.8 mg/kg/dose Q4H (Max 20 mg/dose)
BP check hypertensive 60 min

Malignant hypertension

Consider ICU admission
Labetalol IV bolus 1–3 mg/kg/dose over 1 hr then infusion 1 mg/kg/hr (Max 3 mg/kg/hr)
Nitroprusside infusion iv 0.5–10 mg/kg/min (max 2.5 mg/kg/d)-requires continued BP monitoring

Figure 18.10. Treatment of hypertensive emergencies in childhood.

SEXUAL MATURATION AND ABNORMAL PUBERTAL DEVELOPMENT

MCC OBJECTIVE

Based on Objective #93-1 (Abnormal Pubertal Development) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Puberty is a critical point in a child's life characterized by biologic, cognitive, and psychosocial changes.
- Early, delayed, or interrupted puberty should be investigated to rule out underlying pathology.
- Sexual maturation is a key component of normal adolescent development and self-image.

APPLIED SCIENTIFIC CONCEPT

- The hypothalamic-pituitary-gonadal (HPG) axis is the system through which the brain signals gonadal production of sex hormones (estrogen, progesterone, testosterone).
- Before puberty, this axis is suppressed and there are low amounts of gonadotropins (LH, FSH) or sex hormones in the serum.
- In the prepubertal stage (1–3 yr prior to puberty), the hypothalamus begins to produce GnRH in a pulsatile fashion during sleep, which results in ↑ levels of LH which acts to mature and enlarge the gonads, resulting in ↑ sex hormones, and the development of secondary sex characteristics.
- By midpuberty, the HPG axis assumes its normal pulsatile activity and secondary sex characteristics are further developed.

CAUSAL CONDITIONS

Normal Puberty

Females:

- Age 8 to 13 (earlier in African American females)
- Typical sequence: thelarche (breast development) → adrenarche (pubic hair, body hair, mild acne, body odor) → growth spurt → menarche

CLINICAL box

Secondary Sex Characteristics

Female

- Breast development (thelarche)
- Increased body hair: pubic hair, axillary hair (adrenarche)
- Widening of hips, ↓ waist-to-hip ratio
- Change in fat distribution (↑ subcutaneous fat around buttocks, thighs, hips)

Male

- ↑ facial, axillary, chest, underarm, pubic hair
- ↑ size of larynx and deepening of voice
- ↑ stature and ↑ muscle mass
- ↑ sweat glands and oil secretions causing acne and body odor
- Enlargement of penis

- Timing: average age menarche is 13 yr, 2 yr after thelarche, and at end of growth spurt

Males:

- Age 9 to 14
- Typical sequence: testicular enlargement → penile enlargement → adrenarche → growth spurt

Precocious Puberty (Figure 18.11)

- Definition: onset of secondary sexual characteristics before age 8 (females) or age 9 (males)

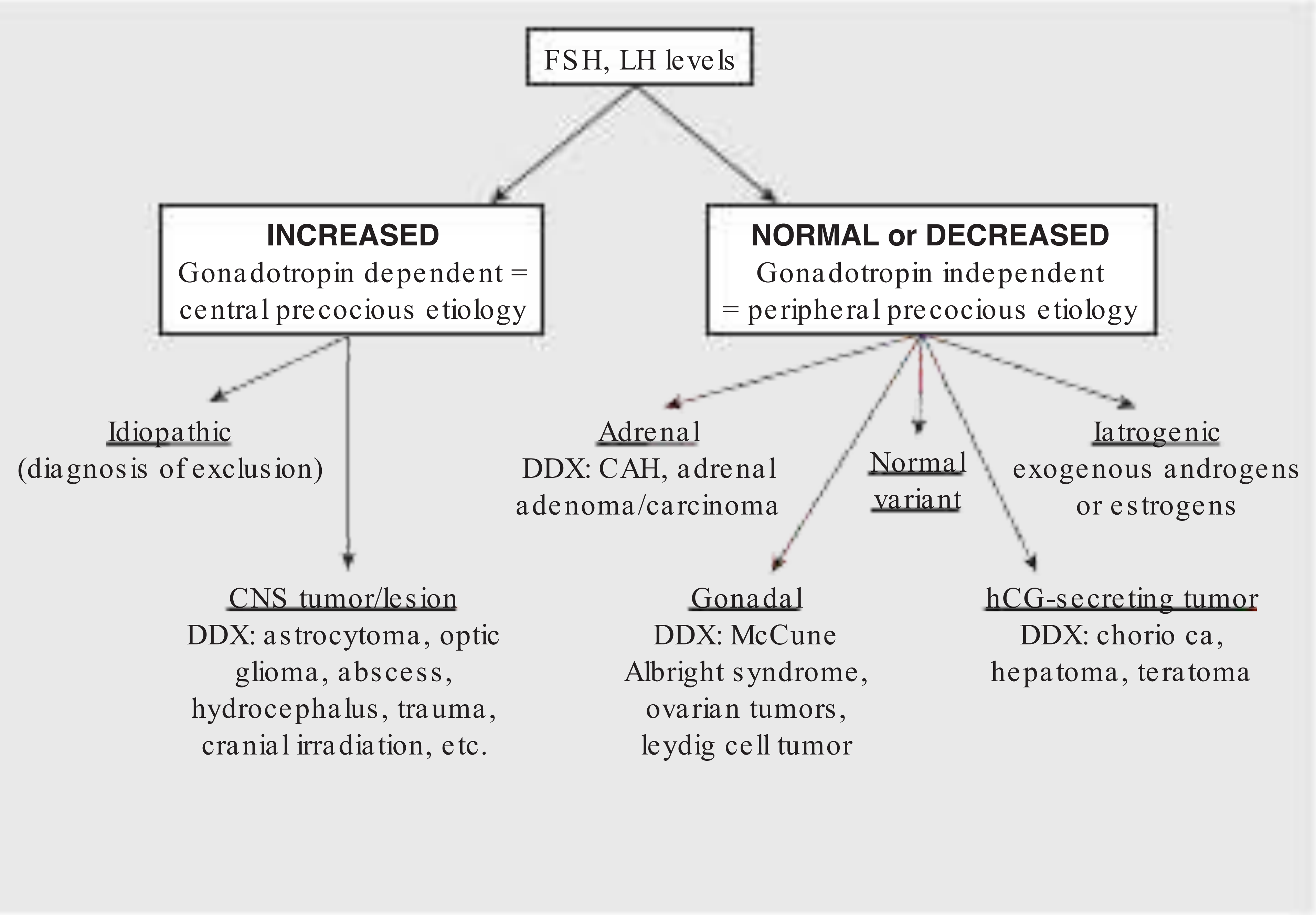

FSH, LH levels
INCREASED
Gonadotropin dependent = central precocious etiology
NORMAL or DECREASED
Gonadotropin independent = peripheral precocious etiology
Idiopathic
(diagnosis of exclusion)
CNS tumor/lesion
DDX: astrocytoma, optic glioma, abscess, hydrocephalus, trauma, cranial irradiation, etc.
Adrenal
DDX: CAH, adrenal adenoma/carcinoma
Normal variant
Iatrogenic
exogenous androgens or estrogens
Gonadal
DDX: McCune Albright syndrome, ovarian tumors, leydig cell tumor
hCG-secreting tumor
DDX: chorio ca, hepatoma, teratoma

Figure 18.11. DDx of precocious puberty.

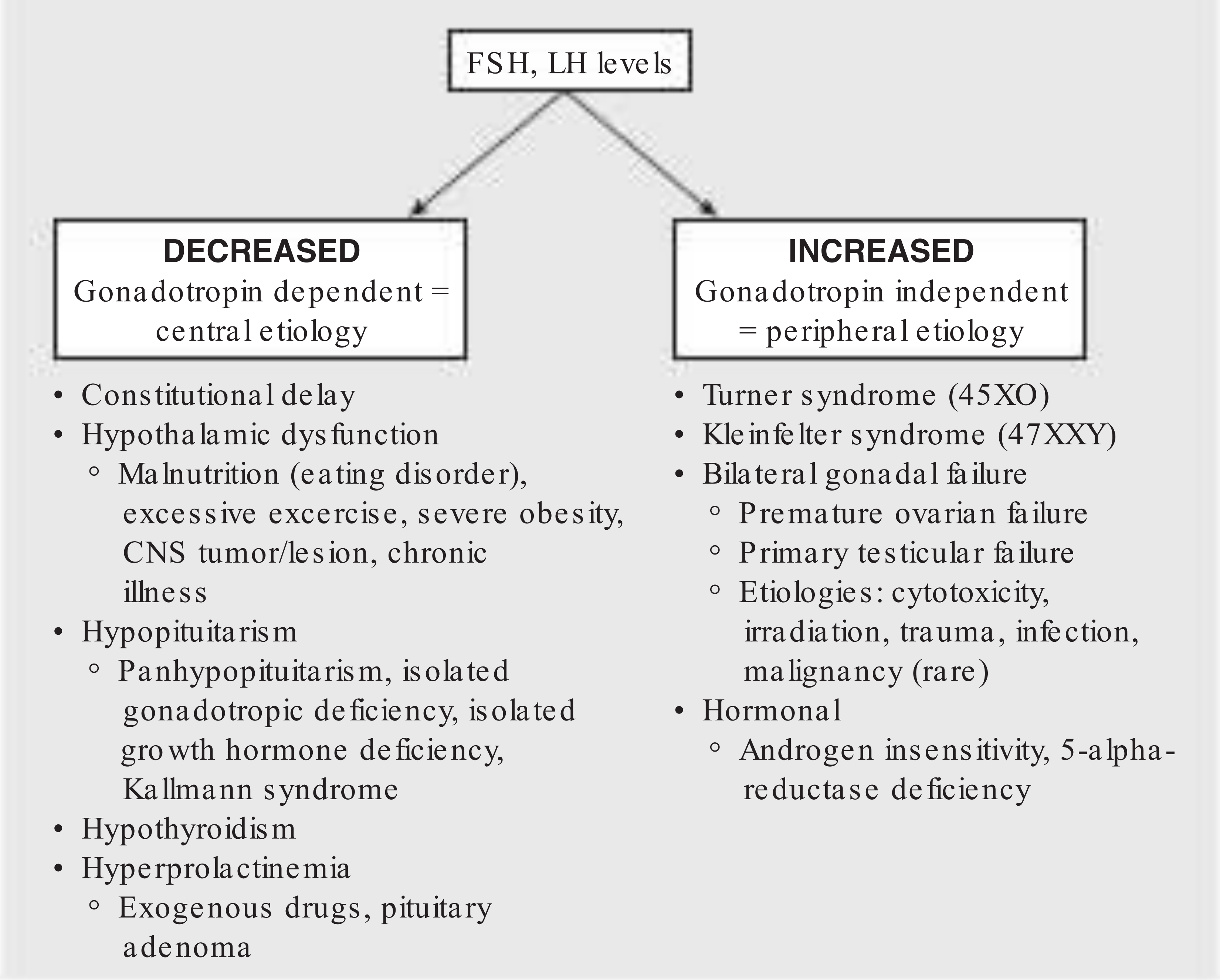

FSH, LH levels
DECREASED
Gonadotropin dependent = central etiology
INCREASED
Gonadotropin independent = peripheral etiology
• Constitutional delay
• Hypothalamic dysfunction
◦ Malnutrition (eating disorder), excessive excercise, severe obesity, CNS tumor/lesion, chronic illness
• Hypopituitarism
◦ Panhypopituitarism, isolated gonadotropic deficiency, isolated growth hormone deficiency, Kallmann syndrome
• Hypothyroidism
• Hyperprolactinemia
◦ Exogenous drugs, pituitary adenoma
• Turner syndrome (45XO)
• Kleinfelter syndrome (47XXY)
• Bilateral gonadal failure
◦ Premature ovarian failure
◦ Primary testicular failure
◦ Etiologies: cytotoxicity, irradiation, trauma, infection, malignancy (rare)
• Hormonal
◦ Androgen insensitivity, 5-alpha-reductase deficiency

Figure 18.12. DDx of delayed puberty.

- 5 to 10× more common in females than in males
- Females: 90% idiopathic
- Males: 75% CNS abnormality

Delayed Puberty (Figure 18.12)

- Definitions:
  - Sexual maturation not apparent by 13 yr of age (girls) or 14 yr of age (boys) **or**
  - Absence of menarche by age 16 **or** within 5 yr of pubertal onset (females)
  - M > F, females more likely to have underlying pathology
  - Must rule out overall growth failure

APPROACH

History

- ID: age, gender
- Review of systems: symptoms of ↑ ICP (see Red Flag Box), visual changes, anosmia, pelvic pain, galactorrhea, fevers, malaise, weight loss, night sweats
- PMHx: preexisting medical and mental health condition, excessive exercise, medications (including supplements and vitamins)
- Females—menstrual Hx: age at menarche, if menses are regular, length of menses, if they are still having their period or amenorrheic
- Sexual development: presence of secondary sex characteristics, sequence of development, age at development
- FHx: parents' age at puberty (including mother's age at menarche), siblings ages at puberty, Hx of delayed or early puberty in family members, Hx of early neonatal deaths or genetic conditions (syndromes) in family
- Social Hx: HEEADDSSS Hx (see Clinical Box, HEEADDSSS Hx)—must be performed with the adolescent alone

Physical Exam

- Tanner staging is used to determine stage of development of various male and female secondary sexual characteristics, and is a crucial part of your exam.
  - Males: genitals, can use orchidometer to measure testicular volume (< 2.5 cm is prepubertal), penis < 7 cm stretched is prepubertal
  - Females: assessment of breasts, genitalia, hair distribution
- Anthropometrics: plot weight and height percentiles for age on WHO growth curves, note growth velocity
- General: presence of secondary sexual characteristics (acne, facial hair, body habitus)
- HEENT: webbed neck, low set ears, high-arched palate (Turner syndrome); moon facies, dorsocervical fat pad (Cushing syndrome)
- CV: normal peripheral pulses, heart sounds
- Respiratory: inspection—widely spaced nipples, shield chest (Turner syndrome)
- abdo: obese abdo, hair distribution
- Skin: café au lait spots (McCune-Albright syndrome), striae (Cushing syndrome—suggests adrenal tumor)

Sensitive exam

The intimate nature of pubertal assessments necessitates that special care must be taken during these exams.

- A same-sex, nonrelated chaperone should always be offered.
- Adolescents should have the option to be examined without their parents in the room.
- Take the opportunity to emphasize the safety of the environment and the context of the exam, especially to young children
- Be explicit about what will be done during the exam, using medical and neutral terminology
- An intensely negative reaction to pubertal assessment out of keeping with a patient's developmental stage may be a sign of a Hx of sexual abuse. Take the appropriate steps to further investigate and contact children's aid services if there is a concern.

Can MeD

CLINICAL box

Normal variations of Puberty

- Premature thelarche: isolated breast tissue in females first 2 yr of life
- Premature adrenarche: isolated pubic hair before age 8 (females) or age 9 (males)
- Premature menarche: isolated vaginal bleeding—must rule out sexual abuse

In setting of abnormal puberty, a CNS mass must be ruled out

CLINICAL box

HEEADDSSS Hx

Home, education, employment, Activities, Drugs, Diet, Sexuality, Suicidality/Mood, Safety

SIGNS AND SYMPTOMS OF ↑ ICP

Morning headache, projectile vomiting, focal neurologic symptoms, papilledema on exam

Bitemporal hemianopsia suggests a pituitary mass.

Testicle volume > 3 mL in boys under 9 y.o. is indicative of central precocious puberty and must be investigated.

Testicular volume < 3 mL+ features of precocious puberty suggest adrenal or exogenous source of testosterone.

Investigations

- Serum FSH and LH levels
  - Will be ↑ in acquired gonadal failure by adolescence
  - If normal or ↓ constitutional delay is most common but must exclude other pathologies
- Estradiol (if female), total testosterone (if male), TSH, GnRH test (to look for ability of pituitary to respond to GnRH), prolactin, 17-OH-P based on clinical features
- Markers of chronic disease: CBC, ESR
- If central etiology suspected, signs and symptoms of ↑ ICP → MRI or CT of head
- Bone age
- Pelvic U/S
- Adrenal U/S
- Karyotyping if peripheral delayed puberty and clinical features suggested of chromosomal abnormality

CLINICAL box

Bone Age Interpretation

- Bone age reflects degree of bone maturation (↑ with ↑ sex steroid hormones).
- Precocious puberty: bone age > chronological age
- Delayed puberty: bone age < chronological age

Management

- Consider referral to pediatric endocrinologist

Central Precocious Puberty

- Pharmacologic treatment is important to ensure that full adult height potential is achieved
- GnRH analogs, GnRH agonist (Lupron)—turns off the HPG axis by ↓ GnRH receptors
- Medroxyprogesterone: slows breast and genital development

Peripheral Precocious Puberty

- Treat underlying cause—may require surgical management if ovarian, CNS tumor
- Glucocorticoid replacement for CAH

Central Delayed Puberty

- Ensure optimal nutrition and health status
- Constitutional delay:
  - Reassurance, emphasize no effect on adult height and development
  - Hormonal therapy (estrogen, testosterone) may be considered in some cases to initiate puberty, especially in the context of adverse psychosocial effects.
  - Exogenous hormone administration requires regular follow-up and monitoring.
- Hypogonadism requires lifelong sex steroid replacement.

Peripheral Delayed Puberty

- Treat underlying cause
- In all cases, support should be offered as abnormal pubertal development can cause significant psychological and emotional distress.

AMBIGUOUS GENITALIA

MCC OBJECTIVES

Based on Objective #36-2 (Congenital Anomalies, Dysmorphic Features) and Objective #93-1 (Abnormal Pubertal Development) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- **Ambiguous (or atypical) genitalia:** congenital abnormalities of the external genitalia, that are not clearly that of a male or female
- **Disorders of Sex Development (DSD)** is a diagnostic category that refers to atypical development of chromosomal, gonadal, or phenotypic sex.
- Early recognition and management of ambiguous genitalia are critical for medical and psychosocial reasons.

CLINICAL box

The term DSD has replaced the former pejorative terms "hermaphrodite" and "intersex." There has also been movement away from the term "ambiguous genitalia" toward DSD.

APPLIED SCIENTIFIC CONCEPT

- Normal sexual and gonadal differentiation depends on multiple genetic pathways (Table 18.32).
- Mutations in these genes can lead to DSD.

TABLE 18.32 • Normal sexual differentiation

Gestational Age	XY Fetuses	XX Fetuses
5 wk (sexually indifferent)	• Paired gonadal ridges • Wolffian and Müllerian ducts	• Paired gonadal ridges • Wolffian and Müllerian ducts
6 wk	• Begin expressing SRY (sex-determining region on the Y chromosome) • SRY → initiates testis formation	• SRY is not expressed (as there is no Y chromosome).
7 wk (bipotential gonad formation)	• Testicular development begins. • Sertoli cells secrete MIS → induces Müllerian duct regression • MIS (Müllerian-inhibiting substance) is also known as AMH (anti-Müllerian hormone). • Leydig cells produce testosterone → stabilizes the Wolffian ducts and promotes development of the epididymis, vas deferens, seminal vesicle.	• Lack of MIS/AMH → Müllerian duct maturation into oviduct, uterus, cervix, and upper vagina • Lack of testosterone → Woffian duct regression
9 wk (sexually distinct external genitalia)	• Peripheral synthesis of DHT (dihydrotestosterone) • DHT → differentiation and growth of male external genitalia • Complete by 12–16 wk	• Non-hormone-dependent vaginal and urethral separation • Complete by 12 wk

CAUSAL CONDITIONS

- Ambiguous genitalia are caused by mutational defects that affect the production or function of hormones and enzymes important for sexual and gonadal development (Figure 18.13).

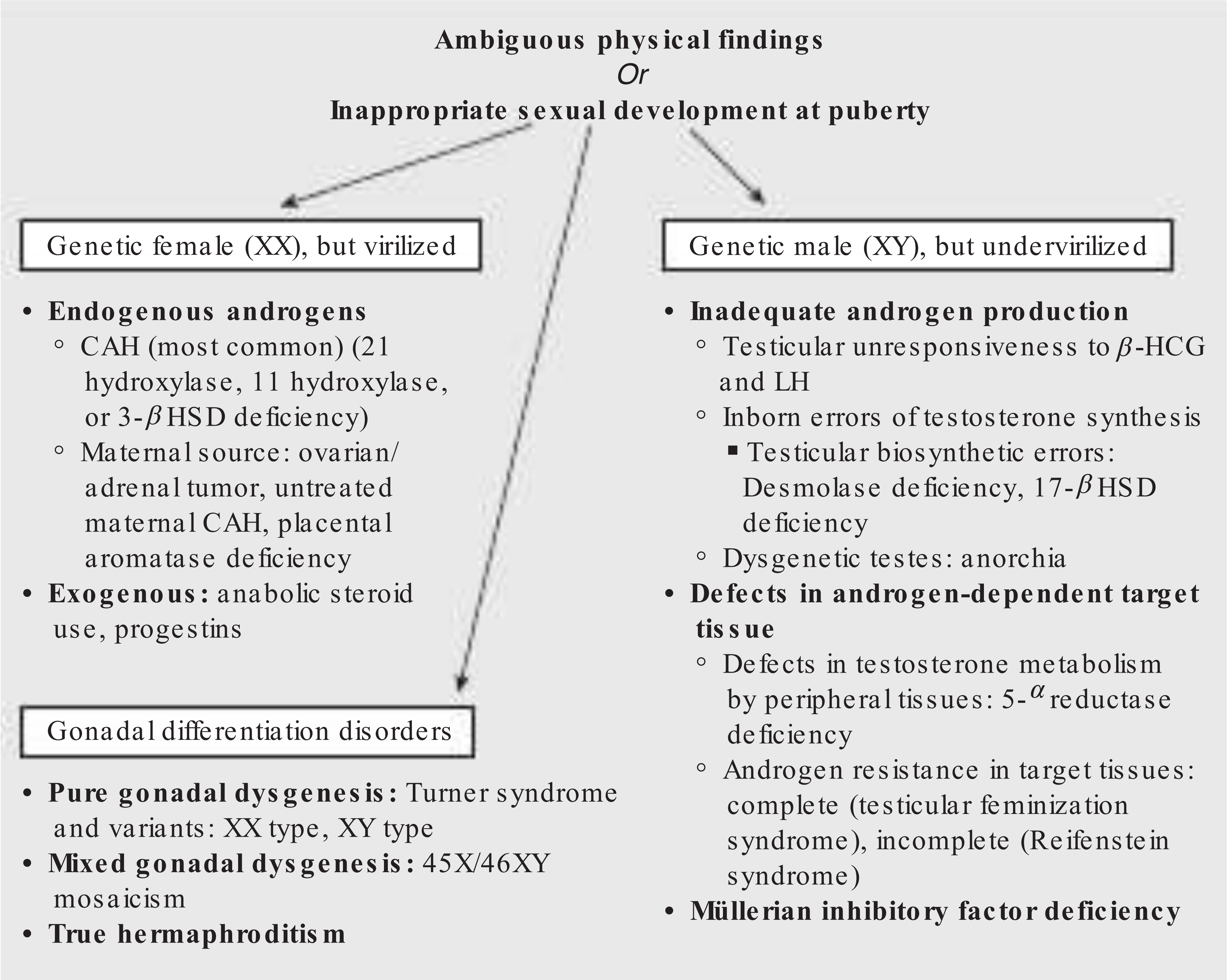

Ambiguous physical findings
Or
Inappropriate sexual development at puberty
Genetic female (XX), but virilized
• Endogenous androgens
◦ CAH (most common) (21 hydroxylase, 11 hydroxylase, or 3-β HSD deficiency)
◦ Maternal source: ovarian/adrenal tumor, untreated maternal CAH, placental aromatase deficiency
• Exogenous: anabolic steroid use, progestins
Gonadal differentiation disorders
• Pure gonadal dysgenesis: Turner syndrome and variants: XX type, XY type
• Mixed gonadal dysgenesis: 45X/46XY mosaicism
• True hermaphroditism
Genetic male (XY), but undervirilized
• Inadequate androgen production
◦ Testicular unresponsiveness to β-HCG and LH
◦ Inborn errors of testosterone synthesis
▪ Testicular biosynthetic errors: Desmolase deficiency, 17-β HSD deficiency
◦ Dysgenetic testes: anorchia
• Defects in androgen-dependent target tissue
◦ Defects in testosterone metabolism by peripheral tissues: 5-α reductase deficiency
◦ Androgen resistance in target tissues: complete (testicular feminization syndrome), incomplete (Reifenstein syndrome)
• Müllerian inhibitory factor deficiency

Figure 18.13. Causal conditions of ambiguous genitalia.

- **Congenital Adrenal Hyperplasia (CAH)** is the most common cause of ambiguous genitalia and can be associated with life-threatening adrenal insufficiency in the first few weeks of life.
  - CAH is most commonly due to 21-hydroxylase deficiency (autosomal recessive *CYP21A2* gene mutations).
    - Results from the defective conversion of 17-OH-P to 11-deoxycortisol
    - Pathophysiology: decreased cortisol synthesis → increased ACTH → adrenal stimulation
  - Classical presentation: during the neonatal period and early infancy with adrenal insufficiency
    - Depending on degree of aldosterone deficiency, most are classified as "salt-losing", and some are "non-salt-losing" (simple virilizing form).
    - Females have genital ambiguity → usually picked up earlier on exam.
    - Males do not have genital ambiguity → may present with salt-losing adrenal crisis.
      - FTT, dehydration, electrolyte abnormalities
  - Late onset CAH: presents with signs of androgen excess
    - Childhood: (includes non-salt-losing form in males) accelerated bone age, premature pubarche
    - Adolescents, adult females: hirsutism, acne, infertility, menstrual irregularity
    - Some children remain asymptomatic.

AppROACh

history

- Prenatal Hx: exposure to androgens (progesterone, danazol, testosterone), maternal virilization in pregnancy (placental aromatase deficiency)
- FHx: ambiguous genitalia, females with infertility or amenorrhea, early infant deaths
- Consanguinity (for recessive disorders such as CAH, 5-a reductase deficiency)

physical Exam

- External genitalia
  - Size and degree of differentiation of the phallus, clitoromegaly, hypospadias, hooded
  - Urethral meatus: perineal urogenital sinus
  - Labioscrotal folds: separated or fused at the midline; pigmented or not
- Gonads
  - Palpability of gonads is the most important exam finding that will direct workup.
  - Palpate for gonads in the inguinal and scrotal areas
- Rectum
  - Possible palpation of the cervix and uterus, confirming internal Müllerian structures
  - The uterus is relatively enlarged in a newborn because of the effects of maternal estrogen, permitting easy identification.
  - Document the number of urogenital opening
- Secondary sexual characteristics in adolescents
  - Males: gynecomastia
  - Females: virilization (hirsutism, acne)
- Associated nongenital anomalies or dysmorphic features

Investigations

- Labs to determine the sex chromosomes and assessment of gonadal and adrenal steroids
  - Karyotype: to establish chromosomal sex
  - FISH to evaluate for the SRY gene
  - To rule out CAH (due to 21-hydroxylase deficiency): 17-hydroxyprogesterone
  - To rule out CAH (less common types): DHEA, androstenedione, testosterone
  - ACTH stimulation test, cortisol level (if suspecting adrenal involvement)
  - 5-a reductase levels: in undervirilized genetic male
  - Serum electrolytes: if concern for salt-wasting CAH (risk of adrenal crisis)
- Imaging: to determine the presence of structures
  - U/S of the abdo and pelvis: for gonads, uterus, vagina; enlarged adrenals in CAH
- Subspecialist referral (endocrinology)

Diagnosis

- The clinical presentation, laboratory, and imaging investigations are all important for the Dx.

Management

- CAH:
  - Salt-wasting CAH/adrenal crisis: fluid resuscitation, glucocorticoid, and mineralocorticoid replacement
  - Long-term: requires follow-up and monitoring of adrenal function
- Counsel and offer long-term, multidisciplinary support to assist in decisions regarding gender assignment and options for surgery
- Psychosocial support: community resources, social support groups

> !
>
> Consider CAH in patients with persistent sodium and potassium abnormalities, cortisol deficiency, or hemodynamic instability

CHILD ABUSE AND NEGLECT

MCC OBJECTIVE

Based on Objective #114-1 (Child Abuse) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Child abuse is defined as intentional harm to a child by the caregiver.
- This includes sexual abuse, physical abuse, and psychological abuse.
  - In Canada, abuse is most commonly seen by injury to the skin.
- Neglect is when a caregiver's omission results in harm to a child by preventing basic needs from being met.
- Abuse causes physical and emotional trauma, leading to significant morbidity and mortality.
- Increased index of suspicion for abuse in children suffering from traumatic injury or those who have psychological or social disturbances (e.g., aggressive behavior, stress, depressive disorder, substance abuse, etc.)

> !
>
> **RED FLAGS FOR CHILD ABUSE**
>
> - Refusal by parent to have child interviewed alone
> - Bruising in children who are not yet cruising
> - Axial and posterior bruising
> - Patterned bruises (handprints, loops, belt marks)

APPLIED SCIENTIFIC CONCEPT

- Bruising indicates blood vessel damage below the skin, usually caused by compressive injury to soft tissues.

CAUSAL CONDITIONS AND RISK FACTORS

- Family dynamics: mental health, addictions, poor social support, poverty
- Parental characteristics: emotional, explosive, angry, irritable, aggressive
- Child characteristics: developmental delay, disability

> **CLINICAL BOX**
>
> Is there an underlying bleeding disorder?
>
> - Postsurgical bleeding (i.e., circumcision)
> - Hematomas with vaccinations
> - Mucocutaneous bleeding, epistaxis
> - Menorrhagia
> - Excess bleeding with dental extractions
> - FHx of bleeding, bruising tendencies

APPROACH

History

- Look for clues in the Hx, such as:
  - Inconsistent or implausible Hx, for example, self-inflicted injuries that are incompatible with the child's development ("no cruising, no bruising")
  - Hx that is vague or lacking in detail
  - Inconsistent Hx
  - No Hx at all offered
  - Attribution of injuries to siblings
- Signs of sexual abuse can include depression and suicidal ideation, sexually aggressive behavior/advanced sexual knowledge, nightmares, low self-esteem.
- Developmental Hx is important, as abuse or neglect can manifest as delay.
- Always consider an underlying medical condition
  - DDx includes nutritional deficiencies (vitamins K and C), infectious (meningococcemia), inflammatory (HSP, ITP), malignancy (and thrombocytopenia), and genetic (coagulopathies, osteogenesis imperfecta)

Must differentiate child abuse from cultural therapy such as “cupping,” “coining,” “spooning,” etc.

Can MeD

Physical Exam

- A thorough, head to toe physical exam is indicated to evaluate for signs of abuse.
- It is important to inspect the entire skin of the child; therefore, he or she must be changed into a gown.
- Anthropometric measures: plot growth parameters
- Head and neck: oropharynx, signs of head trauma (e.g., shaken baby syndrome)—retinal hemorrhages
- MSK: fractures of multiple bones, unusual fractures—ribs, vertebral, scapular
- Skin: bruises in unusual locations (axial is less likely to be due to normal activity vs. appendicular), bruises or fractures in nonambulatory children, or in abnormal patterns
- Neurologic: signs of head trauma—seizures, lethargy, apnea, irritability
- Genitourinary: bruising, injuries, condylomata, abnormal discharge, vesicular or ulcerated lesions

Investigations

- Consider skeletal survey/bone scan; CT/MRI if appropriate
- If sexual abuse is suspected, consider pregnancy test, STI testing and prophylactic treatment, sexual assault exam kit if presenting within 72 h of assault
- Blood tests (CBC, INR, PTT, peripheral smear, fibrinogen, vWB, consider factor levels—VI, IX, liver function tests, Cr, urea) can rule out an underlying medical condition.
  - ITP is the most common acquired bleeding disorder.
  - Hemophilia A (Factor VIII deficiency) is the most common inherited bleeding disorder.

Diagnosis

- Dx can come from a combination of Hx, physical exam, and investigations. Even without a certain Dx, remember that all suspicions should be reported to Child Protective Services or the local equivalent.

Management

- Assess and secure the child’s safety
- Manage any presenting injuries and/or health concerns
- If warranted (even if based only on reasonable suspicion), report to Child Protective Services or the local equivalent
- Document events carefully
- Recognize potential physical and psychological sequelae of physical/sexual abuse or neglect including child’s growth and health, mental health issues, peer acceptance, dysfunctional family
- Work with an interdisciplinary team (involving a psychologist, social worker, dietitian, and the patient’s primary care doctor)
- Strategies for prevention of child abuse include family counseling and education, social support, community support, etc.

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CHAPTER

19

Psychiatry

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PSYCHOSIS

MCC Objective

Based on Objective #86 (Psychosis) of *Objectives for the Qualifying Examination*, 3rd edition.

Overview

- Psychosis is an interruption from reality that may affect thought process, thought content, behaviors, and/or perceptions. It is manifested by delusions, hallucinations, disorganized thoughts and behaviors, or failed reality testing. Delusions are fixed, false beliefs that fall outside of cultural norms. Psychosis is a symptom and not a Dx.
- Schizophrenia is characterized by positive symptoms (delusions, hallucinations), negative symptoms (affective blunting, anhedonia, avolition, alogia), and cognitive impairment (attention, concentration, processing speed, learning, memory, executive function).
- The lifetime prevalence of schizophrenia is 1%.
- Age of onset of psychosis in schizophrenia is late teens to mid-30s, and is earlier for men.
- A prodrome is often noted in adolescence when nonspecific symptoms such as social withdrawal, irritability, antagonistic thoughts, and functional decline become noticeable by others. Attenuated psychotic signs present during this time such as suspiciousness and perceptual distortions are thought to have a high positive predictive value for schizophrenia. This is an area of active clinical interest as it is thought that a long duration of untreated psychosis is related to adverse outcomes.

Applied Scientific Concept

- It is thought that there are many schizophrenia susceptibility genes and that epigenetics and environment play a role in the development of disease. Both neurodevelopmental and stress-vulnerability models of schizophrenia have been described. The genetic risk for schizophrenia is 50% when both parents are affected, and 60% to 84% with a monozygotic twin. Environmental factors include perinatal events, obstetric complications, and social stressors.

- Several neurotransmitters are thought to play a role in producing symptoms of schizophrenia.
- Hyperdopaminergic state in the D_2 striatal system leads to positive system, while a hypodopaminergic state in the prefrontal D_1 system leads to cognitive deficits.
- However, the dopamine theory does not adequately explain negative systems, and it is thought that other monoamine receptors (serotoninergic, histaminergic, muscarinic, a-adrenergic) are contributory. Also, the involvement of acetylcholine is thought to explain the high use of tobacco among patients with schizophrenia. Glutamate and GABA have also been investigated, and activity at the glutamatergic and GABA receptors produces some of the behavioral and cognitive symptoms of schizophrenia.
- The most common anatomical finding is enlargement of the ventricles. PET studies show reduced frontal lobe activation. Functional MRI studies demonstrate functional circuit disruption rather than localized dysfunction. Diffusion tensor imaging looks at the structural integrity of white matter, and decreased coherence has been shown in the prefrontal cortex and in frontotemporal and frontoparietal tracts.

CAUSAL CONDITIONS

- See Figure 19.1

APPROACH

History

- Important notes before beginning the interview:
  - The patient who is psychotic will not be reliable and he or she may have no insight. Collateral information gathered from family, caregivers, ambulance, or available police reports is needed to corroborate information.
  - Make sure that you are safe during the interview. Patients with psychosis may act erratically if they are paranoid, attending to internal stimuli (e.g., command hallucinations).
- Patient identifiers: name, age, occupation
- Social and contextual information: relationship status, living arrangement, work or source of income, children, caregivers of children besides the patient
  - Who is looking after the patient's children? Does social work have to be involved?
- Ask about the *DSM-5* criteria for psychotic disorders (see Diagnosis below)
- Recent and current stressors: personal losses that have occurred or anticipated (e.g., death in family, loss of work, property), role transitions, financial difficulties, interpersonal conflict, isolation
- Social supports available
- Suicide
  - See Table 19.2 Suicide Risk Assessment in the Depressed Mood section
- Screen for symptoms of depression, mania/hypomania, and anxiety
- Substance use
  - Comorbid substance use is common.
- Forensic history
- Psychiatric history
  - For the multiepisode patient, it is crucial to know what medications have been tried, which ones worked, the side effects that occurred, and what doses have been tried and for how long.
- Family psychiatric history
  - Particularly important in patients with first-break psychosis
- Medical history
- Medications
- Allergies
- Personal history: childhood relationships, performance in school at different stages, highest level of education, occupations held, relationships in adolescence and adulthood, history of abuse at any stage in life
  - Look for signs of attenuated psychosis in the prodromal period in the first-break patient

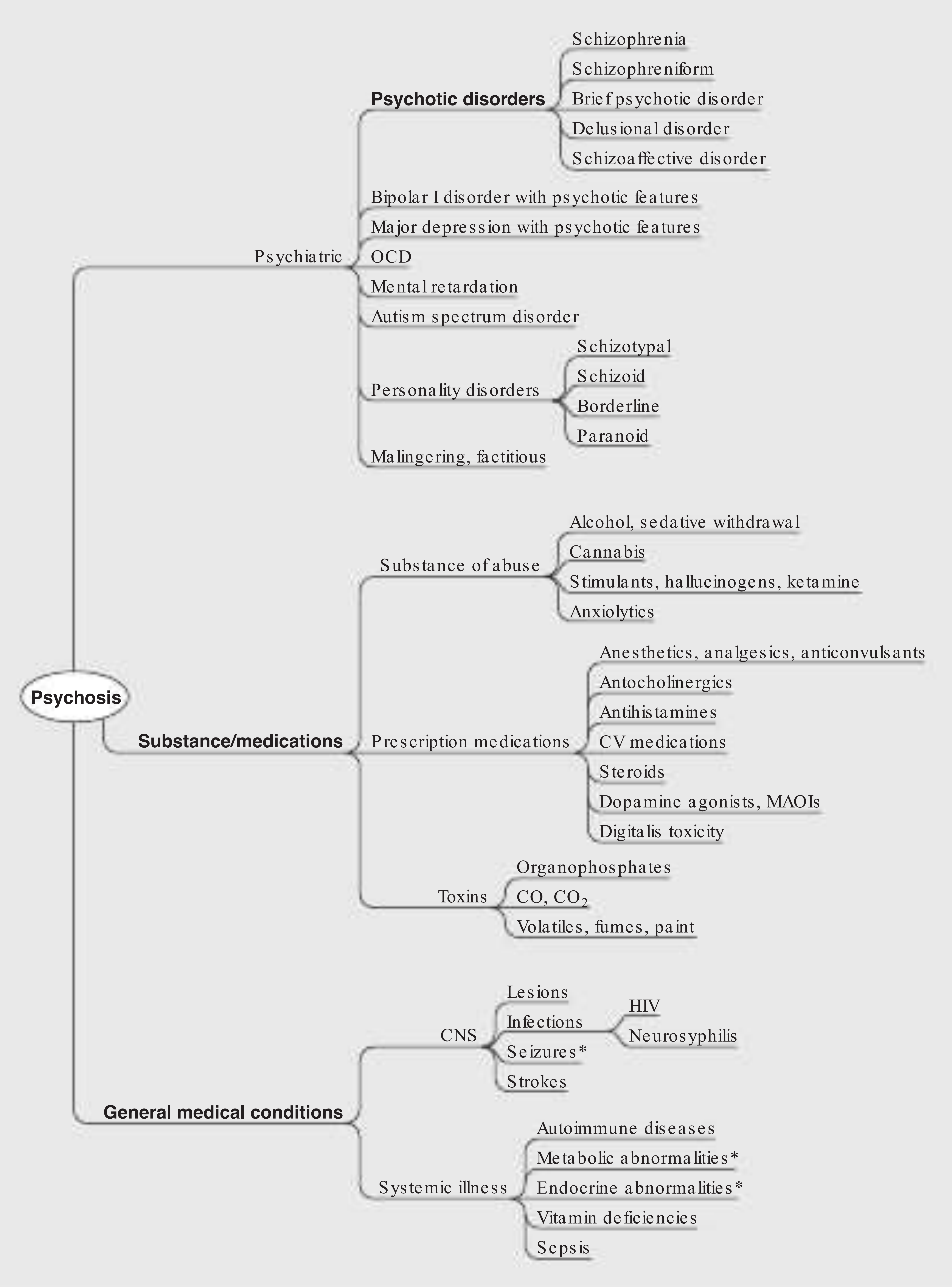


Figure 19.1. DDx of psychosis. Causal conditions listed in the *Objectives for the Qualifying Examination*, 3rd edition, are in bold print. For GMCs, the more known causes of psychosis are marked with an asterisk.

General Observation and Physical exam

- Mental status exam: dishevelled, unkempt, attending to internal stimuli, poor hygiene, nicotine stains on fingers/speech is slow, decreased spontaneity, increased latency in response/affect may be restricted or blunted, may appear perplexed/hallucinations in any sensory modality but particularly auditory/misperceptions of environmental stimulus/thought form may show derailment from linear thinking and incoherence, various pathologies such as echolalia, neologisms, word salad, or there may be thought blocking/there may be delusionary content or a lack of spontaneous thought/often there is no insight and judgment may be impaired by attending to command hallucinations or internal stimulus
- Vital signs, pupils, neurologic exam, signs of self-harm behavior, stigmata of drug or alcohol use, signs of hyperthyroidism, or other metabolic abnormalities
- *The Canadian Journal of Psychiatry Clinical Practice Guidelines* also recommends the following physical exams or assessments at baseline: neuropsychological testing, ocular exam, exam for Parkinsonism and extrapyramidal symptoms, BMI, and waist circumference measurement.
- A functional inquiry into endocrine and sexual functions is also recommended at baseline and monthly for 3 mo when starting a new antipsychotic.

Investigations

- *The Canadian Journal of Psychiatry Clinical Practice Guidelines* for schizophrenia recommends the following investigations at baseline: CBC, electrolytes, renal function tests, toxicology screen, liver function tests, thyroid function tests, fasting plasma glucose, lipid panel, and testing for syphilis and HIV. These may be repeated as indicated clinically.
- Other investigations recommended at baseline may include a head CT or MRI for structural brain abnormalities, ECG, and clinical screening for chromosome 22q11 (with testing if indicated clinically).

diagnosis (Figure 19.2)

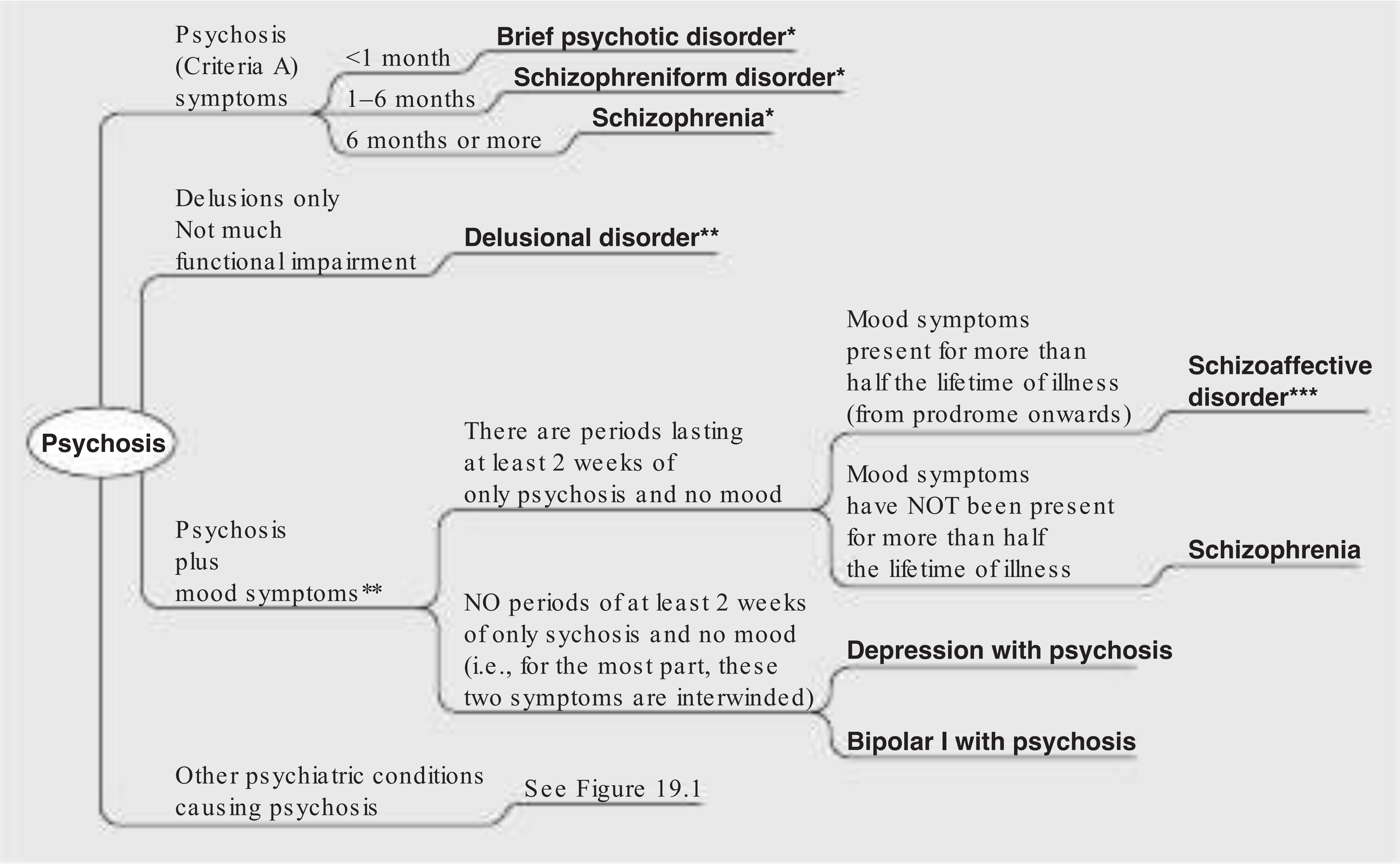

Psychosis
Psychosis (Criteria A) symptoms
<1 month
Brief psychotic disorder*
1–6 months
Schizophreniform disorder*
6 months or more
Schizophrenia*
Delusions only Not much functional impairment
Delusional disorder**
Psychosis plus mood symptoms**
There are periods lasting at least 2 weeks of only psychosis and no mood
Mood symptoms present for more than half the lifetime of illness (from prodrome onwards)
Schizoaffective disorder***
Mood symptoms have NOT been present for more than half the lifetime of illness
Schizophrenia
NO periods of at least 2 weeks of only sychosis and no mood (i.e., for the most part, these two symptoms are interwinded)
Depression with psychosis
Bipolar I with psychosis
Other psychiatric conditions causing psychosis
See Figure 19.1

Figure 19.2. A simplified Dx tree of psychotic psychiatric disorders. For Criteria A of schizophrenia, the patient must have two of the following: delusions, hallucinations, disorganized speech, or disorganized behavior for at least 1 mo and with impairment lasting at least 6 mo or more.

*While a time course is usually used to classify these three, it is important to note that these are not necessarily the same disease entity that is progressing.

**The distinction between bizarre and non-bizarre delusions has been dropped in the DSM-5.

***The diagnosis of schizoaffective disorder (versus schizophrenia versus depression/bipolar I with psychosis) was slightly changed in DSM-5 with respect to the presence of mood symptoms alongside psychotic symptoms. In the DSM-IV-TR, it mood symptoms needed to be present for a “substantial portion of the duration of illness.” In the DSM-5, it needs to be present for the “majority of the total duration” of the illness. This is to give the diagnosis more stability over time.

Management (Table 19.1)

TABLE 19.1 • Management of psychotic patient/thought disorders

Pharmacologic
Important notes

- Titrations.
- Oral (peak plasma levels after 1–4 h) or intramuscular (peak plasma levels after 30 min, with clinical effects starting after 15–30 min).
- Poor subjective response predicts poor compliance—may need long-acting forms.
- An atypical antipsychotic is often used first (less chance in developing extrapyramidal symptoms and tardive dyskinesias that can be debilitating). The trade-off is an increase in metabolic side effects.
- After two failed trials of different antipsychotics (i.e., 6–8 wk at an optimized therapeutic dose), clozapine may be tried.
- Clozapine is the most efficacious medication for treatment of schizophrenia, but has serious side effects that need regular and consistent monitoring (e.g., agranulocytosis, seizures, myocarditis).
- Specialist involvement is necessary for clozapine management. Once started, withdrawal is not to be taken lightly as it is a "last-line" medication.

Antipsychotics	Indications	Contraindications	Adverse Effects
Typical—high potency (haloperidol, fluphenazine)	Positive symptoms; pregnancy (haloperidol)	Preexisting movement disorder/TD	Higher risk of EPS/TD; hyperprolactinemia
Typical—low potency (chlorpromazine, thioridazine)	Positive symptoms	Preexisting movement disorder/TD	Lower risk of EPS/TD; postural hypotension, sedation, anticholinergic (blind as a bat, mad as a batter, dry as a bone, red as a beet, hot as a hare)
Atypical (olanzapine, risperidone, ziprasidone, clozapine, quetiapine, amisulpride, aripiprazole)	Positive or negative or cognitive symptoms; preexisting movement disorders sensitivity (quetiapine or clozapine); treatment refractory (clozapine); suicidality (clozapine)	Diabetes (relative not absolute)	Low risk of EPS/TD; weight gain/hyperglycemia/hyperlipidemia/diabetes/sedation; agranulocytosis (clozapine—need weekly CBC for 6 mo then ≥biweekly CBC); prolonged QT interval (especially quetiapine—need ECG monitoring)

Psychosocial

- Supportive psychotherapy—reassure, explain, clarify, guide, and suggest
- CBT—same as supportive and also to gradually help patient challenge their delusional beliefs by examining evidence for them

Hospitalization

- For suicidal or aggressive patients and patients who cannot care for themselves outside hospital
- For stabilization of acute episodes

Others

- Psychoeducation for patient, caregiver, and family about nature and natural history of psychosis
- Rehab and day programs, case management, supportive housing, ACT teams, community support groups for patients and family members, sheltered work programs
- Emotional support
- Select patients who need specialized care

MANIA/HYPOMANIA

MCC OBJECTIVE

Based on Objective #59-2 (Mania/Hypomania) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Mania is a period of severe and sustained elevated mood that leads to disturbed behavior and function. It may be associated with psychotic symptoms. When the elevation in mood is less severe or more brief, the term used is "hypomania," which can progress to mania.
- Bipolar disorders are characterized by recurrent periods of mania or hypomania, and depression.
- The worldwide lifetime prevalence of bipolar I and II and subthreshold disorders is 0.6%, 0.4%, and 1.4%, respectively (1.0%, 1.1%, and 2.4% for the United States). The median age of onset is about 25 yr.
- Six percent of patients diagnosed with bipolar disorders die through suicide within 20 yr of Dx.

APPLIED SCIENTIFIC CONCEPT

- Interacting genetic and environmental factors affect phenotypic expression of alleles implicated in bipolar disorders. For instance, childhood physical and sexual abuse is associated with earlier onset and illness severity, and stressors can precipitate and perpetuate symptoms.
- There is an average 10x increased risk to develop bipolar disorder among adult relatives of patients with bipolar I and II disorders.

CAUSAL CONDITIONS

- See Figure 19.3

APPROACH

History

- Important notes before beginning the interview:
  - The patient who is manic or psychotic may not be reliable. Mania and hypomania affect insight, and it is not uncommon for patients with bipolar disorder to be unaware that they are ill. Collateral information gathered from family, caregivers, ambulance, or available police reports is needed to corroborate information.
  - Make sure that you are safe during the interview. Patients with mania may be impulsive, irritable, or have labile moods.
  - The patient may not tolerate a full interview. In this case, cover questions looking for diagnostic proof (see Figure 19.3), and those regarding safety (suicide, homicide, who is looking after their children at home).
- Patient identifiers: name, age, occupation
- Social and contextual information: relationship status, living arrangement, work or source of income, children, caregivers of children besides the patient
- Ask about the *DSM-5* criteria for bipolar disorders (see Diagnosis)
- Screen for symptoms of depression, anxiety, or psychosis. The following screening questions may be asked:
  - "Has there ever been a time when you were feeling depressed or very low that you weren't your usual self?"
  - "Do you consider yourself as a 'worrier?'" "Any superstitions or rituals like counting, washing, checking?" "Or thoughts that come into your head that are hard to get rid of?" "Have you ever had panic attacks?"
  - "Do you ever worry that people might be plotting to harm you?" "Do you have any special abilities that other people don't usually possess?" "Are you hearing voices or messages?" "What about visions?"
- Recent and current stressors: personal losses that have occurred or anticipated (e.g., death in family, loss of work, property), role transitions, financial difficulties, interpersonal conflict, isolation

- Social supports available
- Suicide (see Suicide section)
- Substance use
- Forensic history
- Psychiatric history
- Family psychiatric history. Screening for family history of bipolar disorders is critical
- Medical history
- Medications
- Allergies
- Personal history: childhood relationships, performance in school at different stages, highest level of education, occupations held, relationships in adolescence and adulthood, history of abuse at any stage in life

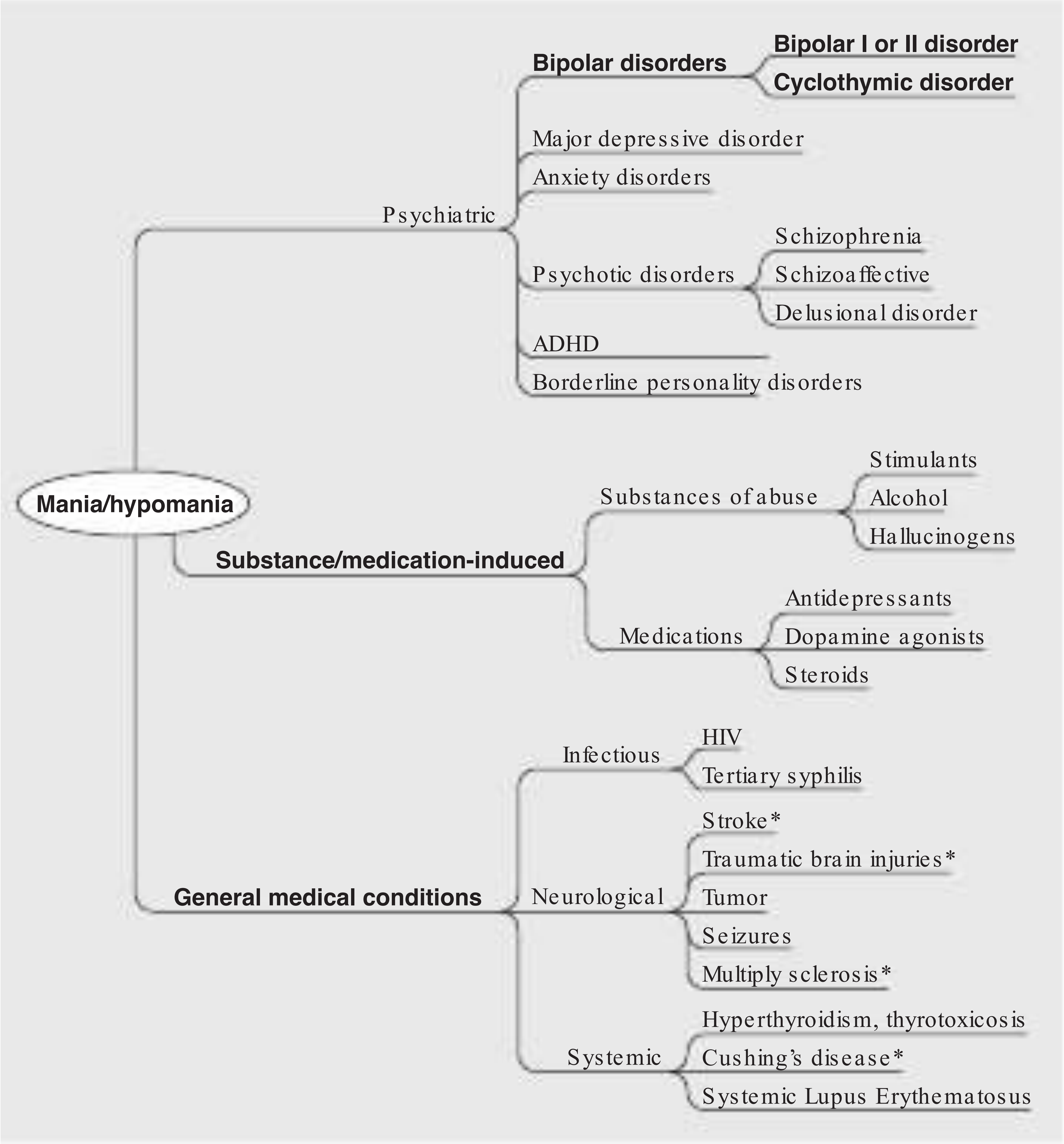


Figure 19.3. DDx of mania/hypomania. Causal conditions listed in the Objectives for the Qualifying Examination, 3rd edition, are in bold print. For GMCs, the more known causes of mania/hypomania are marked with an asterisk.

General Observations and Physical exam

- Mental status exam: presentation is varied, maybe dressed in brighter colored clothing, agitated, aggressive, violent, or in catatonic stupor/poor attention, distractible/mood is often expansive, feels connected to people in his surroundings/affect may be euphoric, labile or irritable/flight of ideas/pressured speech/delusions may be grandiose, religious, paranoid, or persecutory/there may be auditory hallucinations often connected to the delusions/often no insight and poor judgment.

- Vital signs, pupils, signs of self-harm behavior, stigmata of drug or alcohol use, signs of hyperthyroidism, weight loss

Investigations

- Blood work = CBC, electrolytes, BUN, creatinine, fasting blood glucose, liver profile, thyroid profile, TSH, B_{12}/folate
- Urinalysis, urine drug screen
- Additional screening: neurologic consultation, CXR, ECG, CT scan as indicated

diagnosis

Manic Episode

- Abnormally and persistently elevated, expansive, or irritable mood and increased goal-directed activity or energy for at least 1 wk (or any duration if hospitalization is necessary). Increases in goal-directed activity or energy are new features in *DSM-5*.
  1. At least three of the following symptoms or four if the mood is only irritable (pneumonic is **GSTPPAID**)
     - **G**randiosity
     - **S**leep decreased
     - Talkativeness
     - Pleasurable activities with painful consequences
     - Pressured speech
     - Activity level increased
     - Ideas (flight of)
     - Distractible
  2. The mood disturbance is sufficiently severe to cause marked impairment in occupational functioning or in usual social activities or relationships with others, or to necessitate hospitalization to prevent harm to self or others, or there are psychotic features.
  3. The symptoms are not due to substances or medical conditions.
  4. If the manic episode occurs after drugs, or medication treatment (e.g., antidepressants or ECT), but persists at the full syndromal level even after treatment is stopped, then there is evidence for bipolar I.

Hypomanic Episode

1. Criterion 1 of manic episode is met, but duration is at least 4 d.
2. Criteria 2 and 4 of manic episode are met.
3. Episodes associated with an uncharacteristic decline in functioning that is observable by others

Bipolar Disorders

- Bipolar I disorder: disorder in at least one manic episode has occurred commonly accompanied by MDE but not required for Dx. Condition should not be better explained by schizophrenia, schizophreniform, schizoaffective, delusional disorder, or other psychotic disorders.
- Bipolar II disorder: disorder in which there is at least one MDE and at least one hypomanic episode without past manic episode. Condition should not be better explained by schizophrenia, schizophreniform, schizoaffective, delusional disorder, or other psychotic disorders.

Cyclothymia

- Disorder in which there are numerous periods of hypomanic and depressive symptoms while not meeting criteria for major depressive episode for at least two years (at least one year in children and adolescents), and never without symptoms for more than two months. There must be no major depressive episode, manic, or mixed episodes, and no evidence of psychosis. The illness is not due to a general medical condition or substance use, and the symptoms cause clinically significant distress or impairment in social, occupational, or other important areas of functioning.

Management

- The CANMAT and ISBD collaborative guidelines for the management of patients with bipolar disorder (updated 2013) guide clinical management of patients with bipolar disorder (Figure 19.4).
- Bipolar disorder is chronic illness requiring multidisciplinary care using a chronic disease management model.

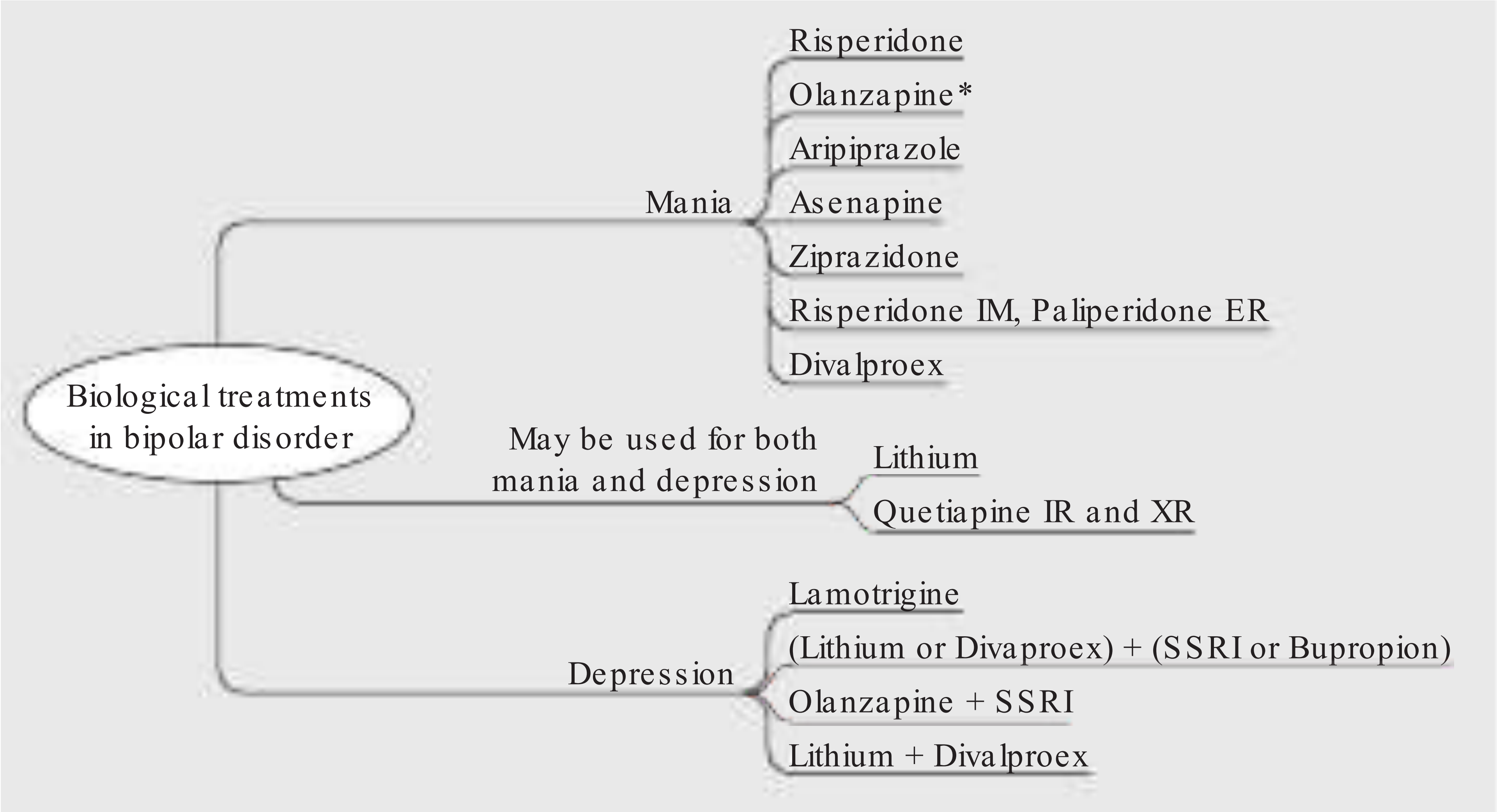

Biological treatments in bipolar disorder
Mania
Risperidone
Olanzapine*
Aripiprazole
Asenapine
Ziprazidone
Risperidone IM, Paliperidone ER
Divalproex
May be used for both mania and depression
Lithium
Quetiapine IR and XR
Depression
Lamotrigine
(Lithium or Divaproex) + (SSRI or Bupropion)
Olanzapine + SSRI
Lithium + Divalproex

Figure 19.4. Biologic treatments in bipolar disorder. Drugs listed are used in the acute and/or maintenance phases of bipolar mania or depression. Olanzapine (marked with an asterisk) is used in the acute treatment of mania, but is used during the maintenance phase mostly for the prevention of bipolar depression. Due to its metabolic side effects, caution should be exercised in prescribing Olanzapine. (Adapted from Yatham LN, Kennedy SH, Parikh SV, et al. Canadian Network for Mood and Anxiety Treatments (CANMAT) and International Society for Bipolar Disorders (ISBD) collaborative update of CANMAT guidelines for the management of patients with bipolar disorder: update 2013. *Bipolar Disord*. 2013;15(1):1–44.)

- The use of symptom checklists can help in the recognition of symptoms of relapse.
- The management goal of acutely manic or hypomanic patients is safety assessment and stabilization:
  - Assess safety/functioning
  - Establish treatment setting
  - Discontinue antidepressants
  - Rule out medical causes
  - Discontinue caffeine, alcohol, and illicit substances
  - Behavioral strategies/rhythms, psychoeducation
- Psychosocial interventions for bipolar disorder include CBT, family-focused therapy, interpersonal and social rhythms therapy, group psychoeducation, and systematic care management. These interventions are delivered in combination with pharmacotherapy, and help identify recurrences, increase acceptance of the illness and adherence to medications, increase coping with stress, stabilize sleep and wake routines, enhance interpersonal communication, and reduce substance use.

DEPRESSED MOOD

MCC OBJECTIVE

Based on Objective #59-1 (Depressed Mood) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- MDD is a mental disorder with primarily depressive features. The *DSM* defines a mental disorder as "a syndrome characterized by clinically significant disturbance in an individual's cognition, emotion, regulation, or behavior that reflects a dysfunction in the psychological, biologic, or developmental processes underlying mental functioning." This definition gives MDD more specificity than the general term "depression." Figure 19.5 summarizes the common causes of depression.
- The 12-mo prevalence of MDD in the United States is 7%. MDD can first occur at any age, but the incidence peaks in the second decade. Females experience MDD at 1.5x to 3x higher rates than males.

- According to the World Health Organization, depression is the leading cause of disability worldwide.

APPLIED SCIENTIFIC CONCEPT

- The pathogenesis of depression is multifactorial. Contributing factors include genetics, neurotransmitter and/or endocrinological dysregulation, cognitive processing deficits, and possible structural and histologic pathologies. Psychological theories have also been described.
- The main neurotransmitters involved in depression are serotonin, norepinephrine, and dopamine. Neuropeptides such as somatostatin and neuropeptide Y act as cotransmitters, and may also be involved. Moreover, the roles of the hypothalamic–pituitary–adrenal and hypothalamic–pituitary–gonadal axes and of thyroid hormones on human emotions have been studied.

CAUSAL CONDITIONS (Figure 19.5)

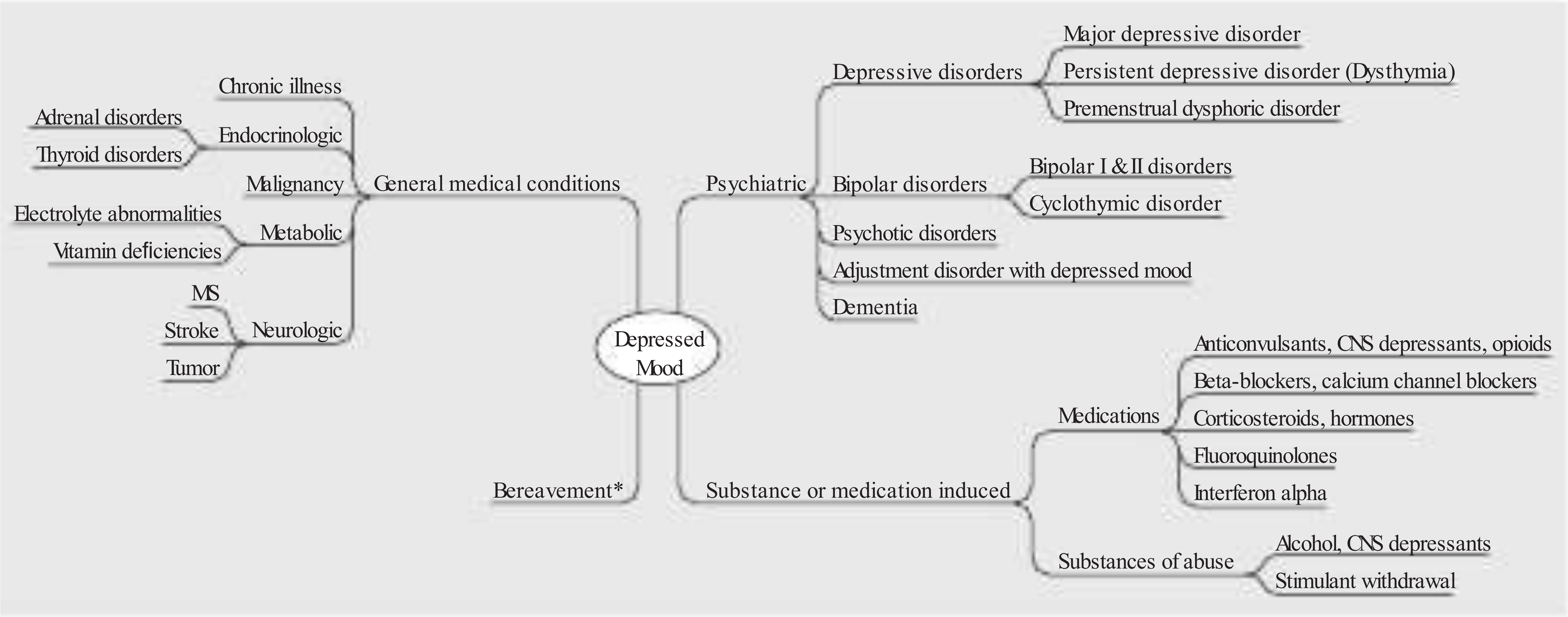


Figure 19.5. DDx of depressed mood. Causal conditions listed in the *Objectives for the Qualifying Examination*, 3rd edition, are in bold print.
*The bereavement exclusion has been taken out of the *DSM-5*.

APPROACH

History

- Patient identifiers: name, age, occupation
- Social and contextual information: relationship status, living arrangement, work or source of income, children, caregivers of children besides the patient
- Ask about the *DSM-5* criteria for MDD (Table 19.2)
- Screen for symptoms of mania/hypomania, anxiety, or psychosis. The following screening questions may be asked:
  - Mania/hypomania: "Has there ever been a time when you weren't sleeping as usual and yet your energy was higher than normal and you were engaged in a lot of activities? Did people around you think this was unusual?"
  - Anxiety: "Do you consider yourself as a 'worrier?'" "Any superstitions or rituals like counting, washing, checking?" "Or thoughts that come into your head that are hard to get rid of?" "Have you ever had panic attacks?"
  - Psychosis: "Do you ever worry that people might be plotting to harm you?" "Do you have any special abilities that other people don't usually possess?" "Are you hearing voices or messages?" "What about visions?"
- Recent and current stressors: personal losses that have occurred or anticipated (e.g., death in family, loss of work, property), role transitions, financial difficulties, interpersonal conflict, isolation
- Social supports available
- Suicide

TABLE 19.2 • Suicide risk assessment

Risk factors	• **SAD PERSONS** **S**ex is Male **A**ge (see Suicide section) **D**epression **P**revious attempt **E**thanol or drugs **R**ational thinking loss **S**eparated, divorced, widowed **O**rganized plan **N**o social support **S**tated future intent (e.g., suicide note) • Based on recent evidence, SAD PERSONS is not a reliable scale to determine risk of suicide. However, it can be used as an acronym for risk factors to think about. • Important for acute risks: hopelessness, current psychiatric illness, non-compliance/response to treatment, impulsivity, anxiety, high distress, drug and alcohol use, organized plan, chronic illness, terminal illness (especially recent Dx) access to lethal means, recent loss, poor access to social supports
Means and lethality	• Access to firearms and weapons • Access to lethal prescription medications or illicit drugs • Isolation from emergency services
Protective factors	• Children, close family members, pets • Religiosity • Good therapeutic relationship with care providers

- Substance use
- Forensic history
- Psychiatric history
- Family psychiatric history
- Medical history
- Medications
- Allergies
- Personal history: childhood relationships, performance in school at different stages, highest level of education, occupations held, relationships in adolescence and adulthood, history of abuse at any stage in life

Physical exam

- Mental status examination: psychomotor retardation, agitation (fidgeting, moving about, hand-wringing, nail biting, hair pulling, lip biting)/decreased eye contact/slowness of speech/depressed mood, dysphoric affect with a decreased range/suicidal ideation and plan, homicidal intent and plan
- Examine vital signs, pupils, and skin for previous suicide attempts, stigmata of drug, and/or alcohol use, thyroid gland, and weight loss

Investigations

- Blood work = CBC, electrolytes, BUN, creatinine, fasting blood glucose, liver profiles, thyroid profiles (TSH), toxicology/drug screen (alcohol, cannabis, opioid, amphetamine/stimulant or cocaine withdrawal or intoxication)
- Urinalysis, urine drug screen
- Additional screening: neurologic consultation, CXR, ECG, CT scan as indicated

Diagnosis

Major Depressive Disorder

1. At least five of the following symptoms (MSIGECAPS) with at least one of depressed mood or anhedonia presented within the same 2-wk period with a change from previous functioning:
   - M: mood depressed
   - S: sleep decreased or increased

- I: interest decreased (anhedonia)
- G: guilt
- E: energy decreased
- C: concentration decreased
- A: appetite decreased or increased
- P: psychomotor agitation or retardation
- S: suicidal ideation

2. The symptoms cause clinically significant distress or impairment in social, occupational, or other important areas of functioning.
3. The symptoms are not due to the direct physiologic effects of a substance or GMC.
4. The symptoms are not better accounted for by other psychiatric disorders.

For features and specifiers of MDD, see Table 19.3.

For differentiating MDD from grief during bereavement, see Table 19.4.

TABLE 19.3 • Features and specifiers of MDD

With anxious distress	Two or more of the following: feeling tense, restless, concentration problems, worry that something awful may happen, worry that self-control might be lost
With mixed features	Three or more manic or hypomanic symptoms (see Mania Hypomania)
With melancholic features	Loss of pleasure in almost all activities or inability to react to pleasurable stimuli, and three or more of: emptiness of mood, mood worse in the morning, waking up at least two hours before usual time, psychomotor agitation or retardation, significant weight loss, excessive or inappropriate guilt
With atypical features	Mood brightens with positive events (reactive mood), and two or more of: hyperphagia or weight gain, hypersomnia, heavy feeling like lead in arms or legs, interpersonal sensitivity (a long-standing pattern, not just limited to the mood episode)
With mood-congruent psychotic features	Delusions and/or hallucinations are present and has a depressive theme
With mood-incongruent psychotic features	Delusions and/or hallucinations are present and themes are not depressive
With catatonia	There are catatonic features like motoric immobility, excess motor activity, negativism, mutism, peculiar movements, echolalia, echopraxia
With peripartum onset	Onset during pregnancy or within four weeks after delivery
With seasonal pattern	Onset during a particular time of the year, with full remission also at a particular time of the year, and in the last two years, two temporal episodes with no nonseasonal episodes

TABLE 19.4 • Differentiating MDD from grief during bereavement

	MDD	Grief
Predominant affect	Depressed mood Inability to anticipate happiness or pleasure	Emptiness and loss
Dysphoria	Persistent	“Pangs of grief” decrease over days to weeks and occurs in waves
Associated features	Not tied with specific thoughts or preoccupation Pervasive unhappiness and misery	Thoughts or reminders of deceased May be accompanied by positive emotions and humor
Thought content	Self-critical, pessimistic ruminations	Thoughts and memories of deceased
Self-esteem	Feeling of worthlessness and self-loathing is common	Self-esteem is preserved. Derogatory thoughts, if present, involve thoughts of failing the deceased (e.g., not saying how much they loved them, not visiting often)
Suicidal ideation	Thoughts are focused on ending life due to feelings of worthlessness, or inability to cope with depression	Thoughts about possibly “joining” the deceased

Persistent Depressive Disorder

The *DSM-5* consolidates the *DSM-IV* defined chronic MDD and dysthymia.

1. Depressed mood for most of the day, depressed for more days than not, as indicated either by subjective account or observation by others, for at least 2 yr[†]
2. At least two of the following while depressed:
    - Poor appetite or overeating
    - Insomnia or hypersomnia
    - Low energy or fatigue
    - Low self-esteem
    - Poor concentration or difficulty in making decisions
    - Feelings of hopelessness
3. During the 2-yr period[†] of the disturbance, the person has never been without the symptoms in criteria 1 and 2 for more than 2 mo at a time.
4. There has never been a manic episode, a mixed episode, or a hypomanic episode, and criteria have never been met for cyclothymic disorder.
5. The disturbance is not better explained by a persistent psychotic disorder.
6. The symptoms are not due to the direct physiologic effects of a substance or a GMC.

- The symptoms cause clinically significant distress or impairment in social, occupational, or other important areas of functioning.

Management (Table 19.5)

TABLE 19.5 • Management of depressed mood

Biologic: Start and Optimize a First-Line Antidepressant[a]		
Escitalopram	Allosteric serotonin reuptake inhibitor	10–20 mg
Sertraline	SSRI	50–200 mg
Venlafaxine	SNRI	75–375 mg
Duloxetine	SNRI	60–120 mg
Milnacipran	SNRI	100–200 mg
Mirtazapine	a_2-adrenergic agonist; 5-HT_2 antagonist	30–60 mg
Psychological		
• In both acute and maintenance phases of MDD, CBT and IPT have the most evidence for efficacy. • Other therapies: behavioral activation, cognitive behavioral analysis system of psychotherapy, acceptance and commitment therapy, motivational interviewing, and mindfulness-based cognitive therapy		
Social		
Support group Community resources Family involvement		

[a] Listed are first-line antidepressants with evidence for superiority. Other factors to consider are symptom profile, comorbidity, tolerability, previous response, drug interactions, patient preference, and cost. A complete list of first-line medications is available in CANMAT, refer to Sidney HK, Lam RW, Parikh SV, et al. Canadian Network for Mood and Anxiety Treatments (CANMAT) clinical guidelines for the management of major depressive disorder in adults, Part III: Pharmacotherapy. J Affect Disord. 2009;117(suppl 1):S26–S43.

- The goal of acute treatment (8–12 wk) is remission of symptoms and restoration of function. In the maintenance phase (6–24 mo or longer), the goal is return to full function and prevention of recurrence.
    - Remission is two weeks to two months with no or very few symptoms
    - Recovery is the absence of symptoms (no more than one to two) for two months or more
- The use of validated scales such as the PHQ-9 or QIDS can help guide treatment decisions.
- Refer to specialists for assistance when required

[†] In children and adolescents, duration must be at least 1 yr.

SUICIDAL BEHAVIOR

MCC OBJECTIVE

Based on Objective #105 (Suicidal Behavior) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Psychiatric emergencies are common and serious problems. Suicidal behavior is one of several psychiatric emergencies, which physicians must know how to assess and manage.
- **Suicide:** the act of intentionally terminating one's own life. This may be associated with multiple factors.
- Suicide is a clinical presentation. The etiology can most often be traced to a psychiatric illness.
- The single strongest predictive factor of future suicidal behavior is previous suicidal behavior and attempts.
- Progression of suicidal behavior: suicidal ideation (*thought*) → plan (*consideration*) → intent (*action*)

APPLIED SCIENTIFIC CONCEPT

- Asking about suicide does not initiate suicidal thoughts or actions.
- Key concepts in the progression of suicidal behavior:
  - Suicidal ideation is the thought of ending one's life by suicide.
  - Plan is how the patient considers ending his or her life by suicide.
    - For example, hanging, jumping off a bridge, etc.
  - Intent refers to how committed the patient is in acting on his or her suicidal thoughts and plans.
    - For example, the patient has had *thoughts* of committing suicide with a *plan* to hang himself or herself, but has little *intent* to act on these thoughts because he or she does not want to leave his or her loved ones behind.

CAUSAL CONDITIONS

The DDx for suicide ideation includes the following:

- **Psychiatric disorder**
  - Mood disorders: depression and bipolar
  - Psychotic disorders: schizophrenia (especially with delusions, paranoia, command hallucinations, loss of rational thinking, and disorganized behavior)
  - Substance use disorder: especially with substances that lead to more impulsivity (e.g., alcohol use disorder)
  - Personality disorders: borderline and antisocial show increased suicidal behaviors
  - Anxiety disorders (more common with panic disorder) especially in panic disorder
  - Delirium: altered level of consciousness, which can lead to increase in suicidal behavior
- **Psychosocial stressors**
  - Adverse childhood experience (trauma, emotional/physical/sexual abuse, etc.)
  - Change in marital status (divorced, widowed, break up, etc.)
  - Change in employment (unemployed, loss of skill set, laid off, etc.)
  - Lacking social support (single, no friends, no family, etc.)
- **Other**
  - Chronic medical conditions (cystic fibrosis, cancer, cirrhosis, etc.)

See risk factors in Table 19.6.

Table 19.6 • Acute and chronic risk factors

Acute Risk		Chronic Risk	
Precipitants	Current Mental Status	Demographics	Psychiatric History
Recent loss/separation	Active suicidal ideation	Age > 65 y.o. with highest risk and late adolescent 16–19 yr of age with second highest risk	Mood disorder
Poor health	Suicide intent	Sex = M > F (3:1) in completed suicide and F > M (4:1) in attempted suicide	Schizophrenia
Unwilling to accept help	Suicide plan	Single, widowed, or divorced	Substance abuse (alcohol)
Feeling hopeless	Preparations for death	Unemployed or retired	Impulsivity
Lack of coping strategies	Psychosis	Lack of social support	Irritability/violence
Suicide of another person access to lethality Caregiver/family unavailable	Depression Other untreated mental health disoder Non-response/compliance to medication Addiction Untreated general medical condition Poor access to health care		Past suicide attempts (strongest predictor)
			Prior admissions
			Family history of suicide

APPROACH

History

- Asking about suicide will not initiate suicidal thoughts or actions.
- Screen for a psychiatric disorder (depression, anxiety, psychosis, substance abuse, PD)
- Screen for acute and chronic psychosocial stressors (i.e., loss of a family member, financial difficulties, etc.)
- Past suicide attempts and family history of suicide
- Screen for medical causes such as delirium
- Suicidal thoughts
  - Ask about frequency, intensity, and duration of thoughts
  - How does the patient control these thoughts?
- Suicidal plan
  - Has a plan been formulated? Has a time and date been set?
  - Does the patient have the means of following through on his or her plans? (i.e., patient has purchased a rope to hang himself or herself)
  - What preparations have been made?
- Suicidal intent
  - How committed is the person to carrying out his plan?

General Observations and Physical exam

- Mental status examination: poor eye contact/psychomotor retardation, agitation (fidgeting, moving about, hand-wringing, nail biting, hair pulling, lip biting), distress, restlessness/depressed mood/flat, restricted affect/suicidal or homicidal ideation, plan, and intent. In addition, look for signs of psychosis
- Examine vital signs, pupils, and skin for previous suicide attempts (e.g., cutting), stigmata of drug and/or alcohol use, thyroid gland, and weight loss

Investigations

- Blood work = CBC, electrolytes, BUN, creatinine, fasting blood glucose, liver profiles, thyroid profiles (TSH), toxicology/drug screen (alcohol, cannabis, opioid, amphetamine/stimulant or cocaine withdrawal or intoxication)
- Urinalysis, urine drug screen

- Additional screening: neurologic consultation, CXR, ECG, CT scan, EEG as indicated

Management (Table 19.7)

TABLE 19.7 • Management based on suicidal risk

Low Risk	Intermediate Risk	High Risk
• Reinforce importance of talking • Going to ER when needed • Calling crisis line • Staying with a supportive person • Availability and back up • Instil **hope**!	• Low-risk interventions • Increase frequency of contact • Involve social supports/family • Avoid alcohol or other triggers • Consider voluntary hospitalization	• Intermediate risk interventions • Detention • Admission • Police involvement

- Safety
  - Hospitalization: urgent hospitalization should be considered if the patient is at imminent risk of self-harm.
  - Certification: Mental Health Act Forms should be considered if the patient is not suitable as a voluntary patient (**note:** these differ between each province).
  - Observation: frequent observation by nursing staff should be considered if the patient is at imminent risk of self-harm.
- Capacity
  - Assess patient's capacity to make decisions for himself or herself if patient refuses treatment. If a patient wishes to leave hospital and is voluntary, you should assess the need to make that patient's status involuntary under the provincial Mental Health Act.
- Once safety has been addressed, treat the underlying disorders including **GMCs** or other psychiatric disorders with depression being the most common.
  - Biologic medications
    - Antidepressants
    - Antipsychotics (typical, atypical)
  - Psychological (requiring insight into disorders): psychotherapy, rehabilitation programs, and/or detoxification programs
  - Social: support group, community resources, family involvement
- Important: medications can only be for emergency purposes unless the patient provides informed consent. For example, you *do not need* consent to treat acute agitation. You *do need* consent from the patient to use medications to treat any underlying illness (i.e., depression, schizophrenia, etc.).

ANXIETY DISORDERS

MCC OBJECTIVE

Based on Objective #69 (Anxiety) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Anxiety is part of the human adaptive reactions to external threats by activating the sympathetic nervous system–fight or flight. It is an alerting signal that warns of impending danger and is characterized by an unpleasant, vague feeling of apprehension and often accompanied by autonomic arousal symptoms.
- Fear is an alerting signal to something known, external or definite while anxiety is often unknown, internal and vague.
- Anxiety becomes pathological if:
  - Fear is out of proportion to severity of threat.
  - When social and/or occupational functioning is/are impaired.

C$_2$ L E O

Euthanasia

- On 6 February 2015, the Supreme Court of Canada unanimously ruled in *Carter v Canada (AG)* that Canadian adults who are mentally competent and suffering intolerably and permanently have the right to a doctor's help in dying. The court, however, suspended its ruling for 12 mo to give the government an opportunity to write legislation and draft new laws and policies around assisted dying (*Carter v. Canada [Attorney General]*, 2015 SCC 5. http://scc-csc.lexum.com/scc-csc/scc-csc/en/item/14637/index.do)
- When faced with these issues, physicians should reassure the patients that they will not be abandoned and that continuous care will be provided indefinitely.
- Psychiatric referral should be considered in these types of cases as these patients are more likely to be depressed than having unbearable pain.
- A clear distinction must be made between terminating life-sustaining treatment(s), which is legal in Canada under special circumstances.

APPLIED SCIENTIFIC CONCEPT

- An exaggerated fear response has been postulated in the etiology of AD.
- Research studies have focused on the specific regions of the brain that coordinate fear and store memory for future exposure to the same stimuli, namely, the amygdala and hippocampus.
- Neurotransmitters that connect these brain regions have also been studied extensively, including the dopaminergic, serotonergic, glutaminergic, and GABAergic systems.

CAUSAL CONDITIONS (Figure 19.6)

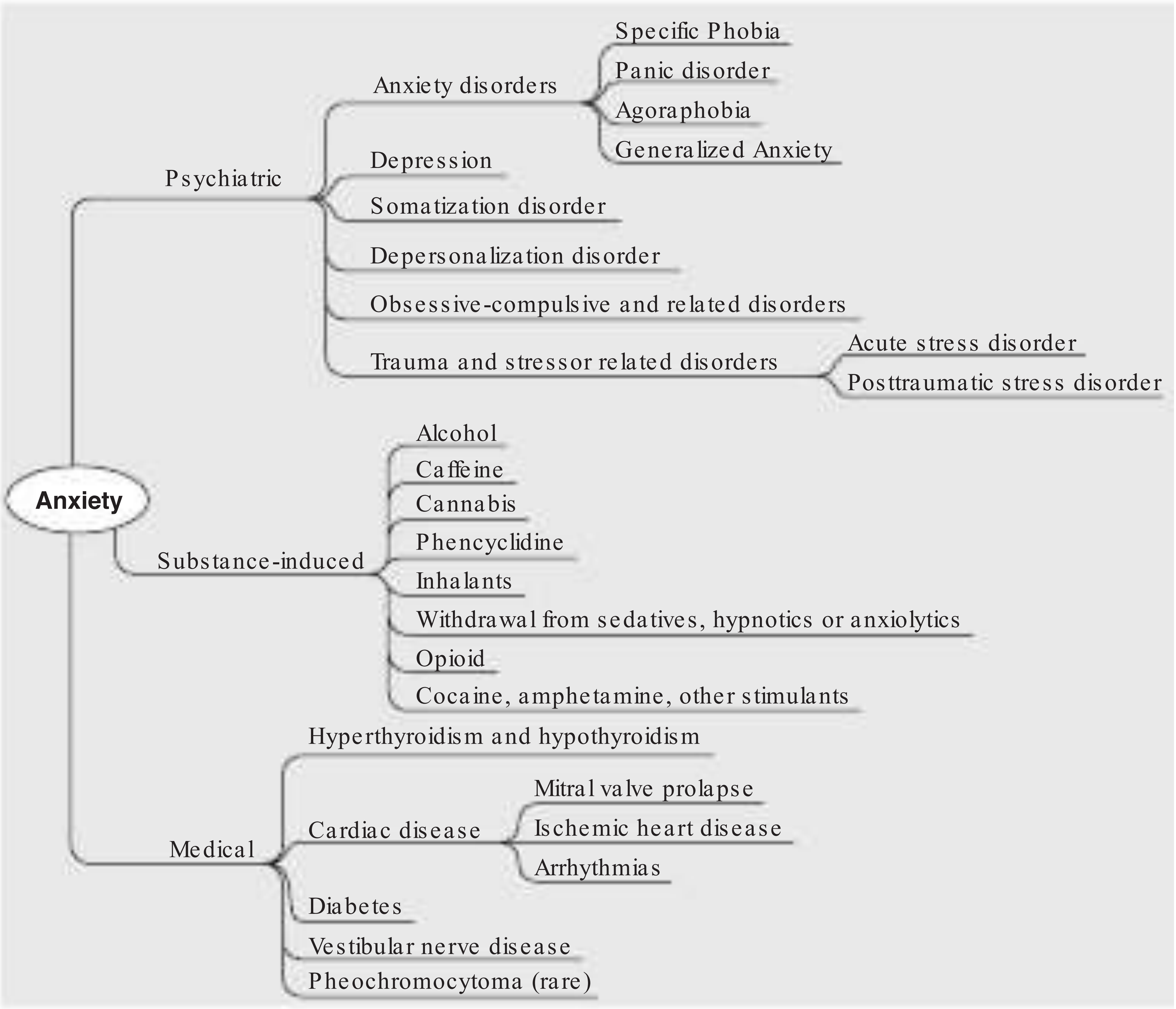


Figure 19.6. DDx of ADs.

APPROACH

History

- Patient identifiers: name, age, occupation
- Social and contextual information: relationship status, living arrangement, work or source of income, children, caregivers of children besides the patient
- Ask about symptoms and features in Figure 19.7
- Recent and current stressors: personal losses that have occurred or anticipated (e.g., death in family, loss of work, property), role transitions, financial difficulties, interpersonal conflict, isolation, exposure to trauma
- Social supports available
- Suicide risk assessment (see Table 19.2 in Depressed Mood section)
- Substance use
- Psychiatry review of systems: screen for symptoms of depression, mania/ hypomania, anxiety, or psychosis
- Psychiatric history
- Forensic history
- Family psychiatric history

- Medical history
- Medications
- Allergies
- Personal history: childhood relationships, performance in school at different stages, highest level of education, occupations held, relationships in adolescence and adulthood, history of abuse at any stage in life

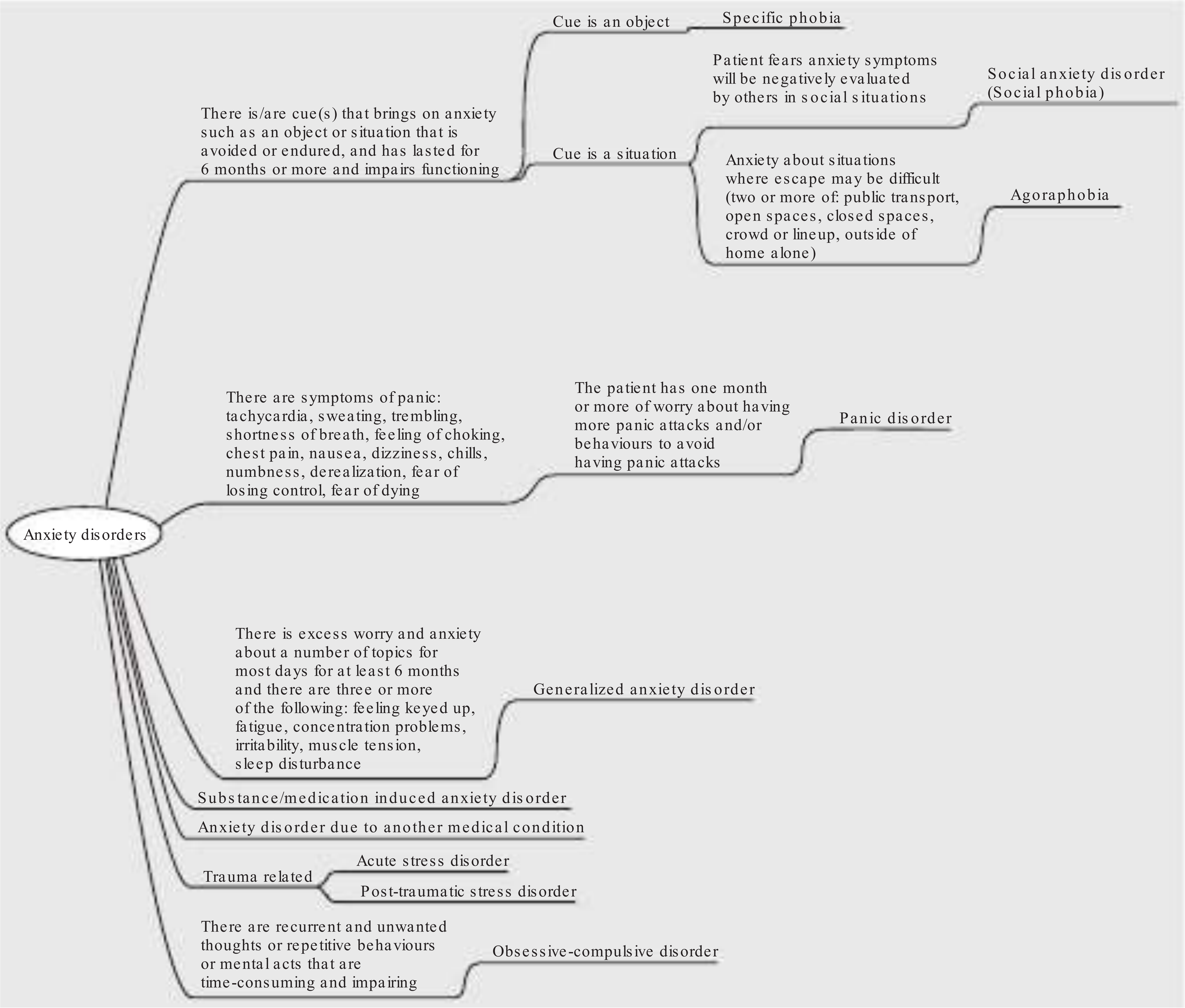

Anxiety disorders
There is/are cue(s) that brings on anxiety such as an object or situation that is avoided or endured, and has lasted for 6 months or more and impairs functioning
Cue is an object
Specific phobia
Cue is a situation
Patient fears anxiety symptoms will be negatively evaluated by others in social situations
Social anxiety disorder (Social phobia)
Anxiety about situations where escape may be difficult (two or more of: public transport, open spaces, closed spaces, crowd or lineup, outside of home alone)
Agoraphobia
There are symptoms of panic: tachycardia, sweating, trembling, shortness of breath, feeling of choking, chest pain, nausea, dizziness, chills, numbness, derealization, fear of losing control, fear of dying
The patient has one month or more of worry about having more panic attacks and/or behaviours to avoid having panic attacks
Panic disorder
There is excess worry and anxiety about a number of topics for most days for at least 6 months and there are three or more of the following: feeling keyed up, fatigue, concentration problems, irritability, muscle tension, sleep disturbance
Generalized anxiety disorder
Substance/medication induced anxiety disorder
Anxiety disorder due to another medical condition
Trauma related
Acute stress disorder
Post-traumatic stress disorder
There are recurrent and unwanted thoughts or repetitive behaviours or mental acts that are time-consuming and impairing
Obsessive-compulsive disorder

Figure 19.7. Diagnosing ADs. In the *DSM-5*, obsessive-compulsive disorder, posttraumatic stress disorder, and acute stress disorder have been reclassified into new sections and are no longer classified under ADs. However, these are listed here to reflect the causal conditions listed in the *Objectives for the Qualifying Examination*, 3rd edition.

General Observation and Physical exam

- Mental status exam: body language, psychomotor retardation/agitation (fidgeting, moving about, hand-wringing, nail biting, hair pulling, lip biting, tremor), decreased eye contact, decreased range of affect (primarily anxious), suicidal/homicidal ideation/plan/intent
- Examine vital signs, pupils, and skin for diaphoresis, stigmata of drug and/or alcohol use, thyroid gland, and weight loss

Investigations (Table 19.8)

TABLE 19.8 • Investigations for ADs

Test	Finding/Interpretation
CBC	To rule out anemia and/or infection
Electrolytes	To rule out electrolyte imbalance
BUN, creatinine	To rule out renal failure
Fasting blood glucose	To rule out hyper- or hypoglycemia
Thyroid (TSH)	To rule out hyper- or hypothyroidism
Urinalysis	Street drugs

Diagnosis (Figure 19.7)

Management (Table 19.9)

TABLE 19.9 • Biopsychsocial treatment for anxiety disorders

Biological

• SSRIs – first-line treatment
  • May initially exacerbate anxiety: start low and go slow
• SNRIs – first-line treatment
• Mirtazapine
• Benzodiazepines
  • Often used for emergency management of generalized anxiety and panic disorders
  • Caution with benzodiazepines for sedation, cognitive effects, and dependence
  • Abrupt withdrawal of benzodiazepines may be dangerous (i.e., risk of seizures, delirium tremens)
• TCAs
• MAOIs
• Buspirone
  • Buspirone has demonstrated efficacy for generalized anxiety but not panic

Psychological
• CBT • Behavioural (exposure) therapy
Social
• Family involvement • Education and support • Support group • Community resources

EATING DISORDERS: Anorexia Nervosa / Bulimia Nervosa

MCC OBJECTIVE

Based on Objective #118-2 (Weight Loss/Eating Disorders/Anorexia) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Eating disorders are a group of diagnoses that can lead to weight loss and significant medical complications, and, therefore, require an understanding of the features of the disorders and its management.

APPLIED SCIENTIFIC CONCEPT

Eating disorders arise from the interplay between genetic, psychological, and social factors. The exact pathophysiology is unknown.

CAUSAL CONDITIONS (Figure 19.8)

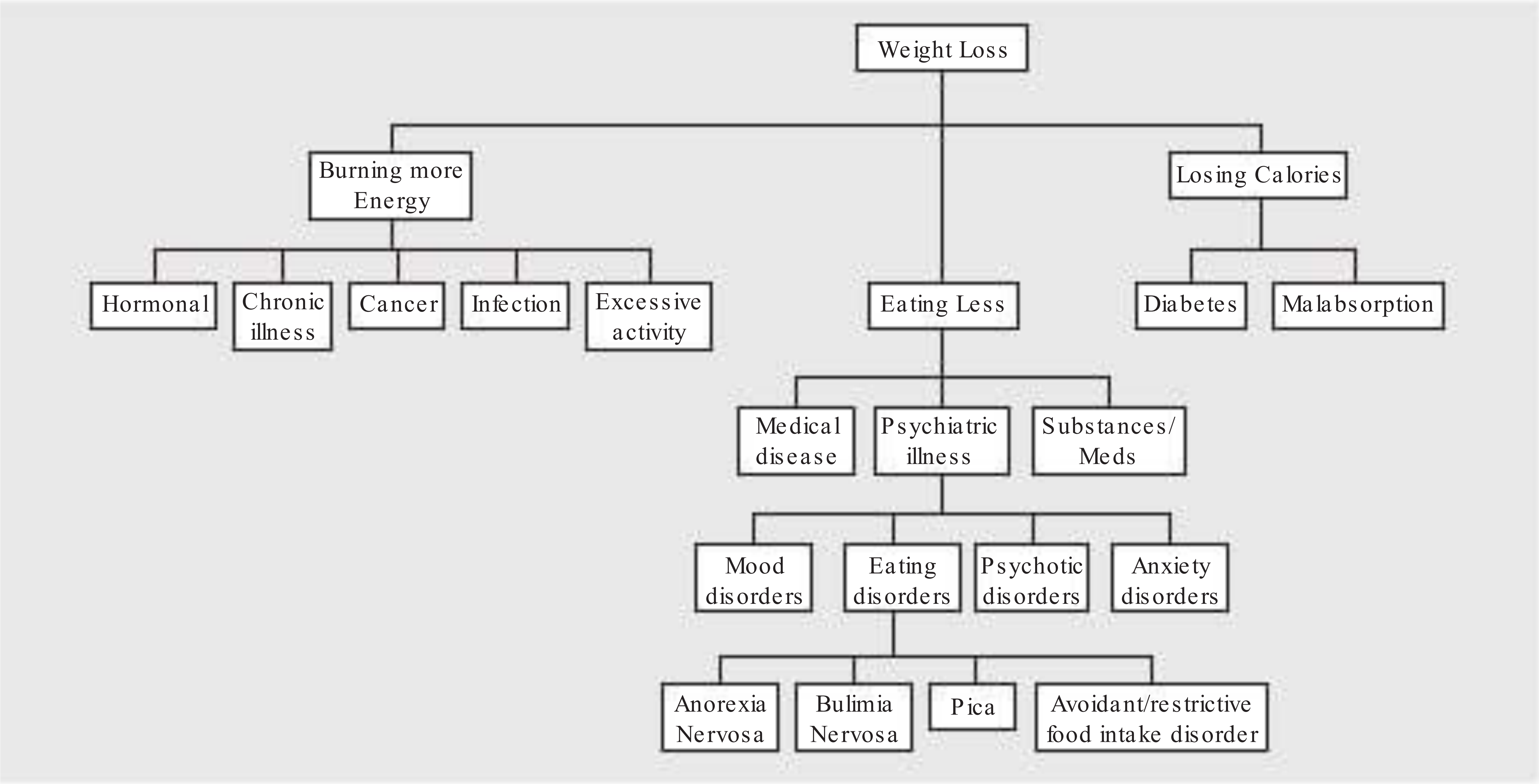


Figure 19.8. Conditions associated with weight loss.

APPROACH

History

- A thorough history is essential to determine if a psychiatric Dx weight loss
  - Psychosocial stressors are particularly important to elicit.
- Weight loss can be part of a wide range of illness including the major psychiatry illness such as major depression or schizophrenia, which are important to rule out.
  - In these causes, the weight loss is a symptom and not the key feature.
- In eating disorders, there is a disturbed eating pattern that can lead to significant weight loss.
  - It is important to elicit the details around the disordered eating to see if the key features of Anorexia Nervosa or Bulimia Nervosa are present (see Diagnosis section).
    - Eating in secrecy (Bulimia Nervosa), calorie counting
  - Pica and avoidant/restrictive food intake disorder are typically diagnoses of childhood.
  - Anorexia Nervosa and Bulimia Nervosa typically start in adolescent but onset can be at any age.
- There is high comorbidity of other psychiatric illnesses, so it is important to do a thorough psychiatric screen.
- Eating disorders have an associated increased risk of suicide, so it is essential to screen for suicidal ideation.
  - See Table 19.2 Suicide Risk Assessment in the Depressed Mood section and Suicide section
- A thorough ROS screening should be done to determine any medical problems such as amenorrhea, constipation, etc.

Physical exam

- Important to document the BMI:
  - BMI may determine Anorexia Nervosa versus Bulimia Nervosa.
  - To assess current severity and follow the course of the eating disorder

- Signs of purging:
  - Teeth changes: enamel erosion, chipped/ragged, dental caries
  - Salivary gland hypertrophy, especially parotid
- Signs of starvation:
  - Lanugo hair (fine downy)
  - Emaciation
  - Peripheral edema

Investigations

- There are no investigations to diagnose an eating disorder.
- Investigations are important to:
  - rule out any medical illnesses causing the weight loss; and
  - determine any physiologic comorbidities induced by the disordered eating.
- Basic investigations: CBC, basic and extended electrolytes, LFTs, TSH, ECG

diagnosis (Figure 19.9)

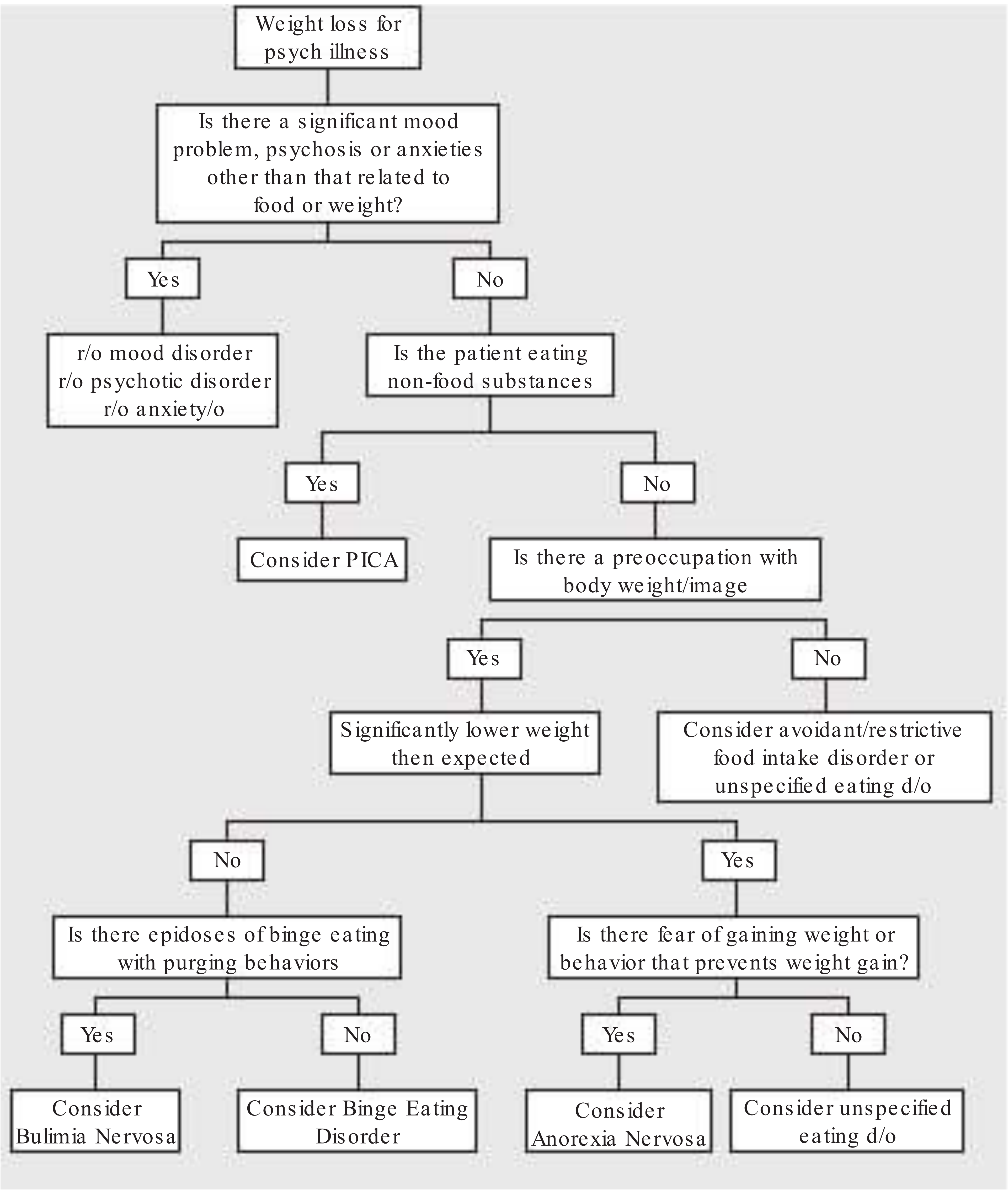

Weight loss for psych illness
Is there a significant mood problem, psychosis or anxieties other than that related to food or weight?
Yes
No
r/o mood disorder
r/o psychotic disorder
r/o anxiety/o
Is the patient eating non-food substances
Yes
No
Consider PICA
Is there a preoccupation with body weight/image
Yes
No
Significantly lower weight then expected
Consider avoidant/restrictive food intake disorder or unspecified eating d/o
No
Yes
Is there epidoses of binge eating with purging behaviors
Is there fear of gaining weight or behavior that prevents weight gain?
Yes
No
Yes
No
Consider Bulimia Nervosa
Consider Binge Eating Disorder
Consider Anorexia Nervosa
Consider unspecified eating d/o

Figure 19.9. Dx of eating disorders.

- Dx of an eating disorder is based on the history and presenting features.
- It is important to rule out causes of weight loss from medical illness, medications, or substance use.
- The key features of:
    - Anorexia Nervosa
        - Persistent restriction of energy intake relative to requirements, leading to significantly low body weight, less than that minimally expected (for age, gender, and developmental trajectory)
        - Intense fear of gaining weight or of becoming fat, or persistent behavior that interferes with weight gain
        - Distorted self-perception (thin girl perceiving herself as a fat person in mirror), overvalued significance of body weight and shape on self-evaluation, or lack of insight into significance of low body weight
        - Can Specify Restricting Type or Binge-Eating/Purging Type
            - Restricted Type - in past 3 months no binge eating or purging behavior
            - Binge-Eating Purging Type - in past 3 months has had recurrent binge eating or purging behavior
        - Mild - BMI > 17, moderate - BMI 16–16.9, severe - BMI 15–15.9, and extreme - BMI < 15
    - Bulimia Nervosa
        - Recurrent episodes of binge eating, consuming more than a normal person and which is accompanied by a sense of lack of control
        - Recurrent inappropriate compensatory behaviors to prevent weight gain (e.g., vomiting, laxatives, excessive exercise, restricting intake)
        - Self-evaluation that is unduly influenced by body shape and weight
        - Episodes inappropriate compensatory behaviors occur on average- 1–3 × a week for mild, 4–7 × a week for moderate, 8–13 × a week for severe, and 14 or more × a week for extreme severity.

Management

- Outpatient psychotherapy is the cornerstone of clinical care for eating disorders.
    - CBT treatment of choice for eating disorders
- Medications, such as SSRIs and antipsychotics, play a limited role in the clinical treatment of Anorexia Nervosa due to limited evidence.
- Some evidence of SSRIs in Bulimia Nervosa to decrease binge and purge episodes, as well as relapse
    - Combo of SSIRs + psychotherapy best outcomes
- Management of complications, such as osteoporosis, may be warranted.
- Hospitalization or day-hospital treatments may be required to restore weight and to address medical complications.

SUBSTANCE-RELATED OR ADDICTIVE DISORDERS

MCC OBJECTIVE

Based on Objective #103 (Substance-Related or Addictive) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- *DSM-5* no longer separates *substance abuse* and *dependence*, but rather generalizes to *substance use disorders.*
- An estimated 10% of the population struggles with substance-related problems.
- There is a high prevalence of psychiatric disorders in substance users (up to 50%), and vice versa.
- *DSM-5* identifies 10 different classes of drugs:
    - Alcohol
    - Caffeine
    - Cannabis
    - Hallucinogens
    - Inhalants
    - Opioids
    - Sedatives, hypnotics, and anxiolytics
    - Stimulants

  - Tobacco
  - Other (or unknown) substances
- Substance use often needs to be ruled out in many psychiatric presentations.

APPLIED SCIENTIFIC CONCEPT

- The central psychophysiology is the direct activation of the *brain reward circuitry*, when any drug is taken in excess.
- Neurotransmitters with major roles in the brain reward system include opioid, dopamine, and GABA.
- Neuroimaging studies reveal the roles of these neurotransmitters in the mesolimbic, hippocampus, amygdala, thalamo-orbitofrontal, anterior cingulate, and frontal cortex regions in maintaining the hedonic effects, cravings, and disinhibited behaviors of addicting drugs.
- These pathways lead to reduced self-control, reinforcement of maladaptive behaviors, and neglect of normal daily activities.
- Genetic factors are strongly linked to alcohol use disorders, but not for other substances.

CAUSAL CONDITIONS (Figure 19.10)

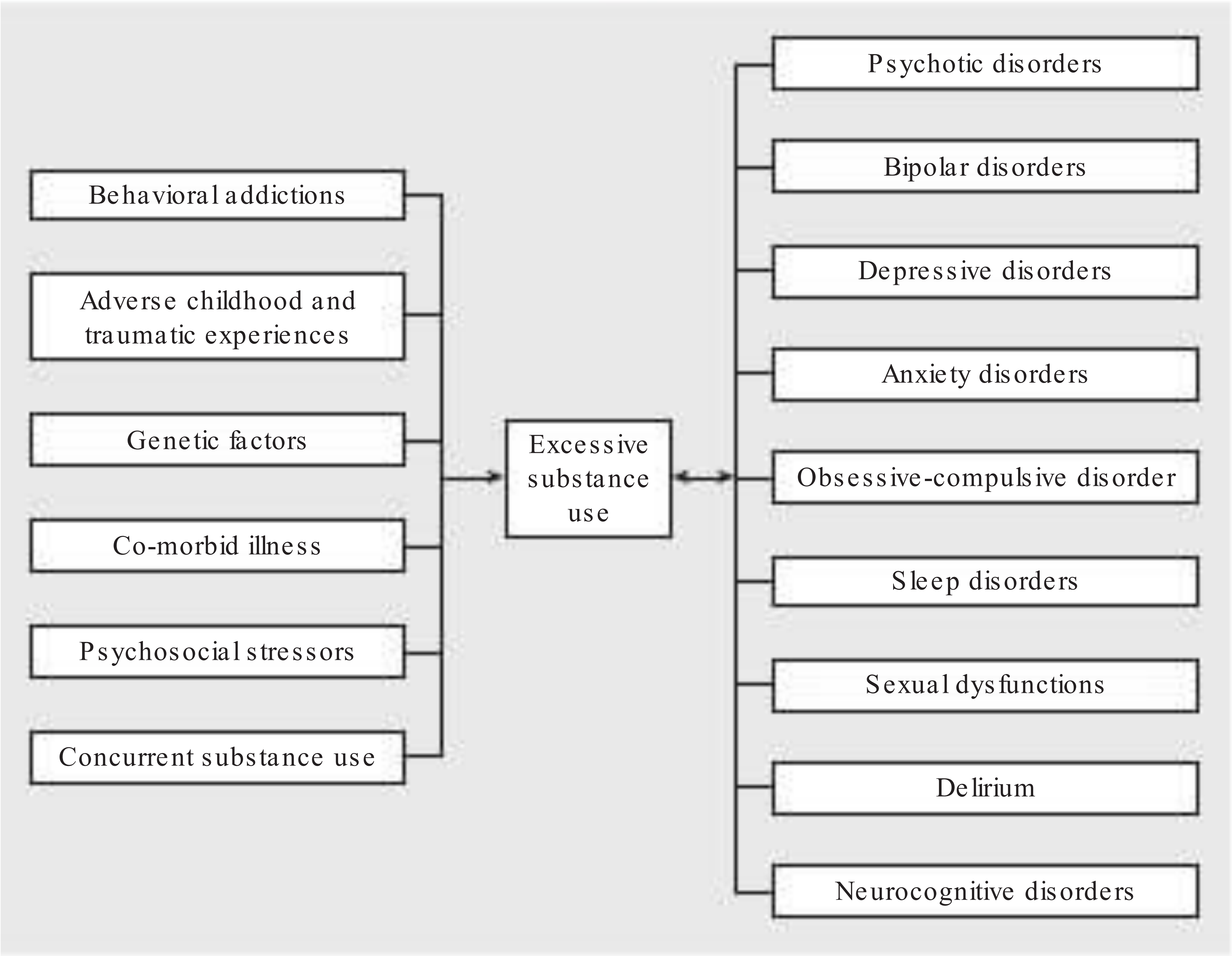


Figure 19.10. Causal factors and DDx associated with substance use.

APPROACH

History

- Ensure personal safety during the interview, as patients with substance intoxication may be erratic, impulsive, and aggressive
- Collateral information gathered from family, caregivers, health care providers, ambulance, or police reports may be needed to corroborate information.
- Perform a structured interview, paying particular attention to drugs of choice and describing for each:
  - Name of the specific drugs, age of first use, current usage, modes of administration, effects obtained from the substances, duration of effects, symptoms of intoxication, symptoms of withdrawal, use of concurrent substances, and functional impairments
- Screen for psychiatric symptoms to assess comorbidities and differential diagnoses (see Figure 19.10)
- Ask about forensic history

General Observation and Physical exam

- Initial medical evaluation is critical.
- Obtain vital signs and assess level of consciousness
- Examine neurologic status, pupils, stigmata of drug or alcohol use, track marks, and other physical signs of substance intoxication and withdrawal
- Perform mental status exam, for instance:
  - Appearance may be emaciated, dishevelled, unkempt, malodorous, poor hygiene.
  - Speech may range from slow with increased latency in response, to pressured and rambling, to slurred and incomprehensible.
  - Affect may be limited in range, or expansive and labile.
  - Thought form may be incoherent, derailed, blocked.
  - Perception may be disrupted by internal stimuli, paranoia, or delusions.
  - Insight and judgment may be impaired.
- Assess for signs and symptoms of toxidromes (Table 19.10).

TABLE 19.10 • Common toxidromes

Toxidromes	Associated/Causative Substances	Symptoms	Signs
Anticholinergic toxidrome *Blind as a bat, dry as a bone, hot as a hare, dry as a bone, red as a beet, mad as a hatter*	Antihistamines Antiparkinson Antipsychotics Benztropine Carbamazepine Tricyclic antidepressants	Agitation Delirium Hallucination Memory loss Urinary retention Visual disturbance	Hypertension Hyperthermia Tachycardia Flushing Mydriasis Decreased bowel sounds Seizures
Cholinergic toxidrome	Anticholinesterase inhibitors Insecticides Nerve gases	Confusion Lacrimation/salivation Vomiting Diarrhea Increased urination	Bradycardia Hypotension Hypothermia Diaphoresis Miosis Seizures
Opioid and sedative-hypnotic toxidromes	Opioids Benzodiazepines Alcohol Sedatives/hypnotics	Altered mental status Confusion Delirium Coma	Hypotension Hypothermia Respiratory depression Miosis (opioids) Hyporeflexia
Neuroleptic malignant syndrome	Antipsychotics Levodopa Lithium Desipramine Phenelzine	Fever Diaphoresis Muscle cramps and stiffness Tremors Agitation Delirium Coma	Hypertensive crisis Muscle rigidity Rhabdomyolysis Elevated WBC Elevated CPK Metabolic acidosis
Serotonin syndrome	Antidepressants: SSRI, SNRI, MAOI, TCA, bupropion, trazodone, mirtazapine Opioids: fentanyl, meperidine, oxycodone, tramadol Amphetamines Cocaine Methylphenidate LSD	Diaphoresis Diarrhea Headache Agitation Hallucinations Coma	Hypertension Hyperthermia Mydriasis Hyperreflexia Myoclonus Clonus
Sympathomimetic toxidrome	Amphetamines Caffeine Cocaine Ephedrine/pseudoephedrine LSD PCP	Diaphoresis Nausea and vomiting Anxiety Delusions Paranoia	Hypertension Tachycardia Mydriasis Hyperreflexia Seizures

Investigations

- Serum and urine toxicology screens are essential.
- Assess baseline CBC + differential, electrolytes, renal function, liver function, thyroid function, fasting plasma glucose, lipid panel, and other laboratory investigations as indicated
- Test for communicable diseases, including hepatitis, syphilis, HIV, etc.
- Other investigations may include ECG, EEG, CT head, or MRI for structural brain abnormalities.

Management (Table 19.11)

TABLE 19.11 • Pharmacologic treatments of substance intoxication and withdrawal

Substance(s)	General Treatment Guidelines
Alcohol	CIWA protocol (Clinical Institute Withdrawal Assessment for Alcohol) is a widely accepted and utilized clinical approach in monitoring and treating alcohol withdrawal: • Diazepam 20 mg PO q1–2h or 2–5 mg IV/min, maximum 10–20 mg q1h, until symptoms abate ◦ If elderly, severe liver impairment, severe asthma, or respiratory failure, use lorazepam 1–2 mg PO/SL t.i.d.–q.i.d. ◦ Thiamine 100 mg IM initial dose, then 100 mg PO once daily × 3 d • Manage with antiepileptics if seizures occur or there is a history of seizures • Manage with antipsychotics if hallucinosis occurs • Supportive care for hydration and symptom management
Opioid	To counter the effects of opioid intoxication, in adults: • Naloxone 2 mg initial bolus IV/IM/SL/SC • Increase by 2 mg increments until symptoms abate, maximum 10 mg Methadone is widely used for detoxification and maintenance in opioid addiction, with carefully titrated and adjusted doses
Tobacco	Nicotine replacement therapies • Nicotine patch: apply one patch (7–21 mg) once daily • Nicotine gum: 2 mg gum PO q1h prn, maximum 20 pieces/d • Nicotine lozenge: 1 mg lozenge PO q1h prn, maximum 20 pieces/d • Nicotine inhaler: 4 mg cartridge inhaler, maximum 12 cartridges/d Varenicline is approved for smoking cessation treatment in adults. • Varenicline 0.5–1 mg PO b.i.d. for 12–24 wk, following 1 wk of titration Though not formally indicated, bupropion has been widely studied and used in smoking cessation. • Bupropion 150 mg PO once daily for 3 d, then 150 mg PO b.i.d. up to 12 wk
Cannabis Stimulants Hallucinogens Caffeine Inhalants Sedatives, hypnotics, and anxiolytics	Supportive care for hydration and symptom management for acute intoxication or withdrawal: • Gastrointestinal decontamination if acute ingestion ◦ Benzodiazepines for seizures or agitation • β-Blockers for hypertension ◦ Vasopressors for hypotension ◦ Antiarrhythmics for dysrhythmias • Antipsychotics for psychotic symptoms

- Psychological and social treatment options:
  - Patient must be willing and committed to engage in behavioral modification and support programs.
  - Many psychological treatment modalities are available, and options may include motivational interviewing, CBT, DBT, relaxation, aversion therapy, assertive training, relapse prevention programs, biofeedback, neurofeedback, and hypnosis.
  - Social treatment options include detoxification centers, residential treatment centers, stabilization facilities, dual diagnoses treatment clinics, outreach programs, Alcoholics Anonymous, Narcotics Anonymous, and other peer support programs.

ADULTS WITH DEVELOPMENTAL DISABILITIES

MCC OBJECTIVE

Based on Objective #21-1 (Adults with Developmental Disabilities) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

The *DSM-5* defines a group of conditions termed "neurodevelopmental disorders", characterized by developmental deficits that result in "impairment in personal, social, academic, or occupational functioning." The Dx of intellectual disability falls within this group, and is defined as objectively confirmed deficits in intellectual function (e.g., reasoning, problem solving, and learning) and deficits in adaptive functioning (e.g., independent living, social participation, and communication), with onset in the developmental period. In Canada, the terms "intellectual and DD" are used synonymously. DD affects between 1% and 3% of Canadians. Adults with developmental disabilities face a myriad of unique physical and mental health issues, which have been increasing in complexity in proportion to this population's lifespan. The primary care physician is the mainstay of care for these adults in the community, and adequate treatment requires nuanced appreciation of the biologic, psychological, and social determinants of health.

It is important to note that not all patients diagnosed with the conditions described below will be intellectually disabled. For example, a proportion of patients with cerebral palsy or autism spectrum disorders will have normal intellectual functioning.

APPLIED SCIENTIFIC CONCEPT

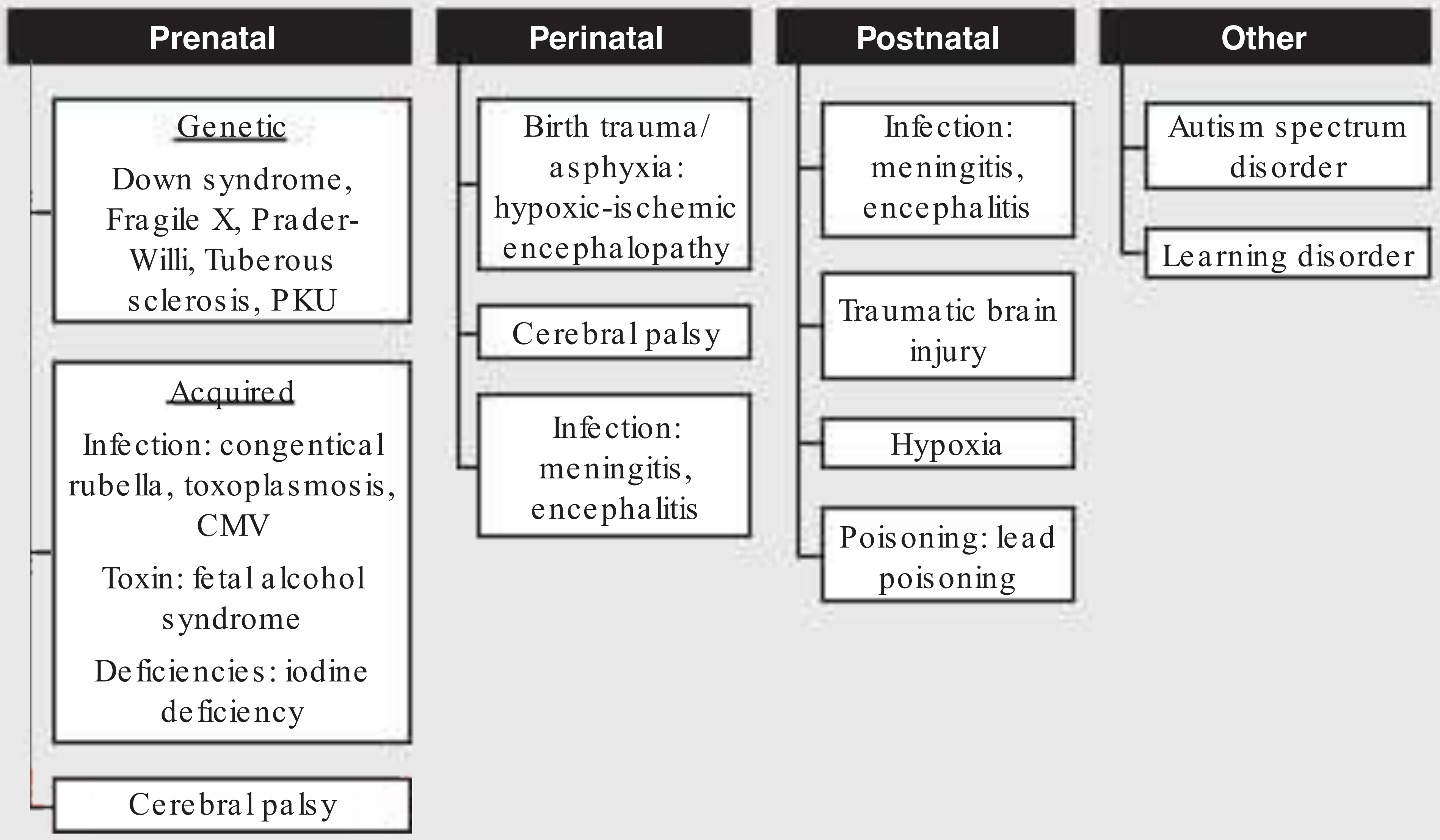
Brain development in the human begins in the third week of gestation and continues in some fashion at least through to late adolescence/early adulthood. The fundamental structures of the brain are established by the end of the embryonic period (eighth week of gestation), and further growth and refinement of these structures continue through fetal development. Disruption of either gene expression (e.g., Down syndrome, Fragile X syndrome) or environmental input (e.g., fetal alcohol spectrum disorders, congenital infections) *in utero* can result in the characteristic phenotypes of the disorders, causing intellectual disability. As brain development continues after birth, postnatal injuries (e.g., cerebral palsy, postnatal infections) may also result in developmental disorders (DD).

CAUSAL CONDITIONS (Figure 19.11)

APPROACH

History (Adapted from Sullivan et al.)

- Adapt language during history taking to the patient's intellectual/adaptive level
- If unknown, establish etiology of DD (see Diagnosis section)
- Assessment of intellectual/adaptive functioning. This may require psychologist referral if patient has not had past assessment or is undergoing a major life transition.
- Detailed social history, including housing, education, occupation, and social supports
- Screen for symptoms of medical disorders that are prevalent in DD
  - Cardiac disease: including CAD and congenital heart disease
  - Respiratory disease: aspiration pneumonia and OSA are common. Screen at least annually for swallowing difficulties.
  - GI: screen annually for symptoms of GERD, and consider GI/feeding problems as a cause of behavioral or weight changes
  - Neurologic: assess for symptoms consistent with seizures/epilepsy as well as early onset dementia
  - Endocrine: screen for symptoms of hypothyroidism and hypogonadism. Patients with Down syndrome in particular have high incidence of thyroid disease.
- Inquire from patient and caregivers about problem behaviors
  - Rule out underlying physical, environmental, or emotional stressors
  - Consider unreported pain as a causative factor


Prenatal
Genetic
Down syndrome, Fragile X, Prader-Willi, Tuberous sclerosis, PKU
Acquired
Infection: congentical rubella, toxoplasmosis, CMV
Toxin: fetal alcohol syndrome
Deficiencies: iodine deficiency
Cerebral palsy
Perinatal
Birth trauma/ asphyxia: hypoxic-ischemic encephalopathy
Cerebral palsy
Infection: meningitis, encephalitis
Postnatal
Infection: meningitis, encephalitis
Traumatic brain injury
Hypoxia
Poisoning: lead poisoning
Other
Autism spectrum disorder
Learning disorder

Note: Cerebral palsy is a static neurological condition characterized by motor and occasionally intellectual impairment caused by brain injury before completion of neurodevelopment (i.e. first two years of life). This injury may occur in the prenatal (intrauterine infections, prenatal strokes, vascular insufficiency), perinatal (birth asphyxia) or post natal (CNS infections, kernicterus, trauma) periods.
Adapted from Management Guidelines, Developmental Disability

Figure 19.11. Causes of developmental disability.

  - Tools such as the Aberrant Behavior Checklist-Community and Psychiatric Assessment Schedule for Adults with DD can be used to screen for psychiatric disorders.
- Assess for signs/symptoms of abuse/neglect
  - Red flags include unexplained injuries, high levels of caregiver stress, inappropriate aggression/sexual behaviors, depression, substance abuse.
- Sexual activity: number of partners, contraception, and STI prevention
- Alcohol and drug use
- Medication review q3mo: indications, dosages, adverse effects, interactions, compliance
- Ensure immunizations (including pneumococcal, influenza) up to date. Consider hepatitis/HIV screening and hepatitis immunizations for at-risk adults.
- Assess capacity to provide informed consent for treatment and/or investigations
  - If a patient is incapable of providing consent, attempts should be made to involve the patient in the decision-making process.

CLINICAL box

Capacity for consent must be assessed before any investigation or treatment that requires consent.

Physical exam

- If etiology not established, examine for characteristic dysmorphisms or neurologic signs (see Diagnosis section)
- Physical exam tailored to comorbid medical conditions and risk factors of disease
  - General: BMI and waist circumference yearly
  - H&N: annual office-based vision and hearing screen (Snellen chart, whispered voice test), dentition, thyroid exam
  - CVS/respiratory
  - Neurologic: focal neurologic signs, repeated cognitive testing to assess for dementia, if possible
  - MSK: scoliosis, spasticity, and/or contractures
- Screening for cervical, breast, testicular, prostate, and colon cancer as per Canadian guidelines

Investigations

- Consider cytogenetic testing if etiology unknown
- Consider further cardio (e.g., ECHO), respiratory (CXR, swallowing studies), and neurologic (EEG) studies as indicated by history and physical exam

- Screen for *H. pylori* infection in symptomatic adults or asymptomatic patients residing in institutions/group homes
- Consider testosterone level in all males at least once after reaching puberty, or in any patients exhibiting hypogonadism
- Consider diabetes screen in patients who are obese or have other metabolic risk factors
- Thyroid function at regular intervals (e.g., q1–5yr) and with changes in behavior/adaptive functioning
- Adults with Down syndrome have specialized guidelines for surveillance (Table 19.12).
- Assess and possibly refer for psychological testing to establish baseline and better detect dementia

Table 19.12 • Health surveillance in adults with Down syndrome

Each health maintenance visit	Review symptoms of celiac disease and investigate as indicated Screen for symptoms of OSA Review cervical spine positioning precautions, assess for symptoms of myopathy
Annual	TSH Hemoglobin Audiologic exam Exam for acquired mitral/aortic valve disease
Every 3 yr	Ophthalmologic assessment for cataracts, refractive errors, corneal thinning, or haze

Adapted from Bull MJ, Committee on Genetics. Clinical report: health supervision for children with Down syndrome. *Pediatrics*. 2011;128:393–406.

Diagnosis

- Features on history leading to Dx
  - Pregnancy: complications of pregnancy, known toxin exposure, congenital infections, perinatal trauma/infections
  - Associated domains of difficulty: physical impairments, social communication, ADHD features
  - Family history of genetic conditions/inborn errors of metabolism
- Exam for characteristic physical and behavioral features (Table 19.13)

Table 19.13 • Diagnostic features of conditions causing developmental disability

Condition	Etiology	Characteristic Features	Investigations
Down syndrome	Sporadic trisomy 21 in 95% of cases Unbalanced translocation in 3%–4%, 25% of these are familial Mosaicism in 1%–2%	Small head Flattened facial features Protruding tongue Upward slanting eyes Single palmar crease Short fingers	FISH study, with positive result followed by chromosome analysis for translocations
Fragile X	CGG trinucleotide repeat of *FMR1* gene on X chromosome	Long face Large ears Hyperextensible joints Macroorchidism Flat feet ADHD Autism Delayed speech Social anxiety	PCR to assess trinucleotide repeats

(continued)

Table 19.13 • (continued)

Condition	Etiology	Characteristic Features	Investigations
Cerebral palsy	Nonprogressive neurologic condition resulting from brain injury prenatally or in first 2 yr of life 70%–80% prenatal of unknown cause 10%–20% postnatal from infections or brain trauma	Spasticity (hyperreflexia, hypertonia, scissors gait, toe walking) in 70%–80% Athetosis (slow, writhing movements) in 10%–20% Ataxia (wide-based gait, intention tremor) in 5%–10% Global developmental and physical dysfunction or isolated disturbances of gait, cognition, or sensation	Clinical Dx based on history, physical exam, and exclusion of progressive neurologic disorders
Fetal alcohol syndrome/ spectrum disorder	Fetal alcohol syndrome: combination of characteristic physical and CNS abnormalities Fetal alcohol spectrum disorder: range of effects resulting from alcohol exposure	Facial anomalies: short palpebral fissures, flat upper lip, flattened philtrum, flat midface Growth retardation CNS: microcephaly, structural abnormalities, neurologic hard/soft signs Behavioral/cognitive difficulties	Confirmed maternal alcohol exposure and characteristic facial, growth, CNS, and/or cognitive impairment FAS without confirmed alcohol exposure diagnosed if facial anomalies, growth retardation, and CNS abnormalities all present
Autism spectrum disorder	Definitive etiology not established in most cases 15% associated with known genetic mutation Environmental risk factors include advanced paternal age, low birth weight, fetal exposure to valproate.	Deficits in social communication/interaction and restricted, repetitive behaviors, interests, or activities Specify if there is accompanying intellectual impairment or language impairment[a]	Clinical Dx using caregiver interviews, questionnaires, and clinician observation tools

[a] Autism spectrum disorder without language impairment was termed Asperger's disorder in previous version of *DSM-IV-TR*.

- Specialized investigations for etiology as guided by history and physical exam
- Routine cytogenetic testing may be indicated if etiology unknown.
- Objective, standardized intelligence testing required to diagnose intellectual disability as per *DSM-5*

Management (Table 19.14)

Table 19.14 • Management of problem behaviors

Behavioral/psychological interventions	Environmental modification Skills development Caregiver support Communication aids CBT for treatment of anxiety/depression Psychotherapy for grief or trauma underlying problem behaviors
All psychotropic medications	Long-term use indicated for confirmed psychiatric Dx (e.g., depression, anxiety, ADHD) "Start low, go slow"—adults with DD often more sensitive to adverse effects Monitor and review medications q3mo
Atypical antipsychotics	If needed for behavioral crisis, attempt to limit use to no longer than 72 h. *Risperidone has FDA approval for use in ASD population to control aggression, explosive outbursts, and self-injury.* Long-term use only indicated for confirmed Dx schizophrenia or other psychotic disorder. If used long-term, monitor for side effects and metabolic syndrome. Educate patients and caregivers about healthy lifestyle to decrease likelihood of metabolic abnormalities.

Adapted from Sullivan WT, Berg JM, Bradley E, et al. Primary care of adults with developmental disabilities: Canadian consensus guidelines. *Can Fam Physician.* 2011;57(5):541–553.

- Involve regional service agencies (including social work, nursing, OT, SLP, and other health care providers) to provide interdisciplinary care
- Referral for psychiatrist, neurologist, psychologist, and/or other specialist as required

CLINICAL box

Behavioral interventions should be considered first line for management of problem.

SEXUALLY CONCERNED PATIENT

MCC Objective

Based on Objective #94 (Sexually Concerned Patient) of *Objectives for the Qualifying Examination*, 3^{rd} edition.

Both male and female patients commonly express concern about sexual issues. Students must be able to set patients at ease in order to facilitate discussion of these issues.

OVERVIEW

The social appropriateness of sexuality is culturally determined. The physician's own sexual attitude needs to be recognized and taken into account to deal with the patient's concern in a relevant manner. The patient must be set at ease to make possible discussion of private and sensitive sexual issues.

APPLIED SCIENTIFIC CONCEPT

Given a patient with sexual concerns, the candidate will diagnose the cause and will initiate appropriate management. Sexuality arises in children and adolescents as expressed by their sexual feelings, behavior, and development. As we age, sexuality changes. Sexuality in females typically decreases with age, while males' sexuality tends to be unchanged throughout life.

CAUSAL CONDITIONS

Sexual Dysfunction

- Sexual dysfunction is some disturbance in sexual interest, arousal, or achieving orgasm. These are subdivided into male and female disorders:
  - *Male erectile disorder:* difficulty in obtaining or maintaining an erection during sexual activity
  - *Female orgasmic disorder:* infrequent or absence of an orgasm or a reduction in the intensity of an orgasmic sensation
  - *Female sexual interest/arousal disorder:* absent or reduced interest in sexual activity, erotic thoughts, sexual excitement, and sexual arousal
  - *Male hypoactive sexual desire disorder:* absent or reduced sexual or erotic thoughts and pleasure in sexual activity

Sexual Paraphilia

- Sexual arousal, fantasies, sexual urges or behavior involving nonhuman objects, suffering or humiliation of oneself or one's partner, children, or others
  - Rarely self-referred, and often come to medical attention through interpersonal or legal conflict
  - Person usually has more than one paraphilia, with only 5% of paraphilia diagnoses attributed to women
  - Typical presentation begins in childhood or early adolescent, increasing in complexity and stability with age but decreasing with advancing age although with chronic presentation, and may increase with psychosocial stressors
  - Please refer to Table 19.15 for the subtypes of paraphilias

Gender Dysphoria

- Strong and persistent cross-gender identification with repeated stated desire or insistence that one is of the opposite sex. Often have an intense desire to participate in the stereotypical games and pastimes of the opposite sex and significant distress or impairment in functioning with his or her sex or gender role.
  - Further subdivided into gender dysphoria in children and gender dysphoria in adolescents and adults, which have unique criteria in *DSM-5* catered to differences in behaviors seen in children and adults/adolescents.
  - Gender identity is set in most people by age 2 or 3 yr.

- Boys develop the disorder before age 4 yr, while girls mostly give up masculine behavior by adolescence.

TABLE 19.15 • Subtypes of paraphilia

Subtype	Definition
Exhibitionism	Recurrent urge of behavior to expose one's genitals to an unsuspecting person
Fetishism	Use of nonsexual or nonliving objects or part of a person's body to gain sexual excitement
Frotteurism	Recurrent urge or behavior of touching or rubbing against a nonconsenting person
Voyeurism	Recurrent urge or behavior to observe an unsuspecting person who is naked, disrobing, or engaging in sexual activities, or may not be sexual in nature at all
Pedophilia	Sexual attraction to prepubescent or peripubescent children
Sexual masochism	Recurrent urge or behavior of wanting to be humiliated, beaten, bound, or otherwise made to suffer for sexual pleasure
Sexual sadism	Recurrent urge or behavior involving acts in which the pain or humiliation of the victim is sexually exciting
Transvestite fetishism	Sexual attraction toward the clothing of the opposite gender
Paraphilia not otherwise specified	• Necrophilia: sexual attraction to corpses • Zoophilia: sexual attraction to animals • Coprophilia: sexual pleasure from feces • Urophilia: sexual pleasure from urine and urination

APPROACH

General Observations and Physical exam

- Observe for general appearance, appropriateness of behavior, body language, distress, agitation, masculine/feminine features
- Examine vital signs, puberty staging, thyroid gland, weight changes, drug and/or alcohol use (needle injection, alcohol breath), concentrate on neurologic exams (especially peripheral neuropathy), and genital exams

Investigations

- Blood work = CBC, electrolytes, BUN, creatinine, fasting blood glucose, liver profiles, thyroid profiles (TSH), toxicology/drug screen (alcohol, opioid, amphetamine/stimulant or cocaine withdrawal or intoxication), FSH/LH, GH
- Additional screening: neurologic/endocrinology/gynecology/urology consultations, CXR, ECG, CT scan as indicated

Management

- A full assessment including family evaluation to identify emotional, behavioral, and separation problems is essential, and unresolved issues in the child's environment are often present such as loss.
- Direct assessment and treatment of other underlying disorders including GMCs and psychiatric disorders should be promptly initiated.
- Testosterone = control of sexuality, fantasies, and behavior; also increases the frequency, duration, and magnitude of spontaneous and nocturnal erections
- Antiandrogenic drugs such as medroxyprogesterone (long-acting contraceptive Depo-Provera) have been used to reduce sex drive in men, but they have many unpleasant side effects, including breast growth, headaches, weight gain, and reduction in bone density.
- SSRIs and lithium have been used to reduce impulse control problems and/or sexual obsessions, and psychostimulants have been used to augment the effects of SSRIs in individuals with a paraphilic disorder.
- Psychotherapy including individual or group therapy and behavioral modification should aim to assist development, particularly that of gender identity, by exploring the nature and characteristics of the atypical organization of the child's or adolescent's gender identity, and focusing on ameliorating the comorbid problems and difficulties in the child's life while reducing the distress being experienced by the child.

- Recognition of the person's inability to control the compulsion, acceptance of the disease and its consequences, and willingness to learn from others in recovery with commitment to change should be discussed.
- Therapist should also provide recognition and acceptance of the gender identity problem and remove its secrecy, while providing guidance for the child's sense of gender identity and support for the family in tolerating uncertainty and anxiety in relation to the gender identity development and how best to manage it.
- Referral for assessment and/or treatment in a multidisciplinary gender identity specialist service should be made if the criteria of gender identity disorder are met.
- Referral to a pediatric endocrinologist for the purpose of physical assessment, education about growth and endocrinology problems, and involvement in any decision about physical interventions should be considered.

CLINICAL box

Physical, Psychological, and Sexual Developmental Processes

There is great fluidity and variability in the outcome, with only a small proportion becoming transsexuals or transvestites and with the majority of affected children eventually developing a homosexual orientation or heterosexual orientation without transvestism or transsexualism.

PERSONALITY DISORDERS

MCC OBJECTIVE

Based on Objective #75 (Personality Disorders) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Personality Disorders (PDs) are chronic conditions, with an estimated prevalence of 10% to 20% in the general population. Approximately, one-half of all psychiatric patients have a PD.
- PDs are an enduring pattern of inner experience and behavior that deviates markedly from the expectations of the individual's culture; they are manifested in two or more of cognition, affect, interpersonal functioning, and impulse control.
- They are often inflexible and pervasive across a range of situations.
- Usually at least age 18 yr for Dx, but pattern well established by adolescence or early adulthood
- Associated with many complications, such as depression, suicide, violence, brief psychotic episodes, multiple drug use, and treatment resistance

APPLIED SCIENTIFIC CONCEPT

- PDs are often a product of an intricate interaction of psychological (e.g., stress), social (e.g., homelessness), and biologic factors (e.g., genetics).
- The Dx of a PD is made when a patient fulfills the *DSM-5* criteria. Therefore, it is imperative to be aware of the *DSM-5* criteria for each disorder.
- Patient can have more than one PD.
- Keep in mind that many patients will demonstrate traits of a particular personality structure, but may not necessarily have a PD

CAUSAL CONDITIONS (Figure 19.12)

DSM-5 Criteria

Cluster A: Eccentric (Odd) and "Mad"

- **Paranoid PD (0.5%–3%) = ê4 diagnostic criteria from "SUSPECT"**
  - **S**: Spouse fidelity suspected
  - **U**: Unforgiving and bearing grudges
  - **S**: Suspicious of others
  - **P**: Perceives attack on his or her character not apparent to others and reacts quickly
  - **E**: Enemy or friend (suspects associates and friends)
  - **C**: Confides in others feared
  - **T**: Threats perceived in benign events
- **Schizoid PD (2%–7%) = ê4 diagnostic criteria from "SOLITARY"**
  - **S**: Shows emotional coldness to others
  - **O**: Omits from social events
  - **L**: Lacks friends
  - **I**: Involved in solitary activities

CLINICAL box

General Diagnostic Criteria

- Behavior deviates markedly from individual's cultural expectations. Inflexible and pervasive across a broad range of personal and social situations, manifesting in ≥2 of:
  - Cognition (perception and interpretation of self, others, and events)
  - Affect (range, intensity, lability, and appropriateness of emotional response)
  - Interpersonal functioning
  - Impulse control
- Often leading to clinically significant distress or impairment in social, occupational, or other important areas of functioning
- Stable and of long duration with onset tracing back to at least adolescence or early adulthood
- Not better accounted for by other psychiatric disorders
- Not due to direct physiologic effects of a substance or a GMC such as head injury

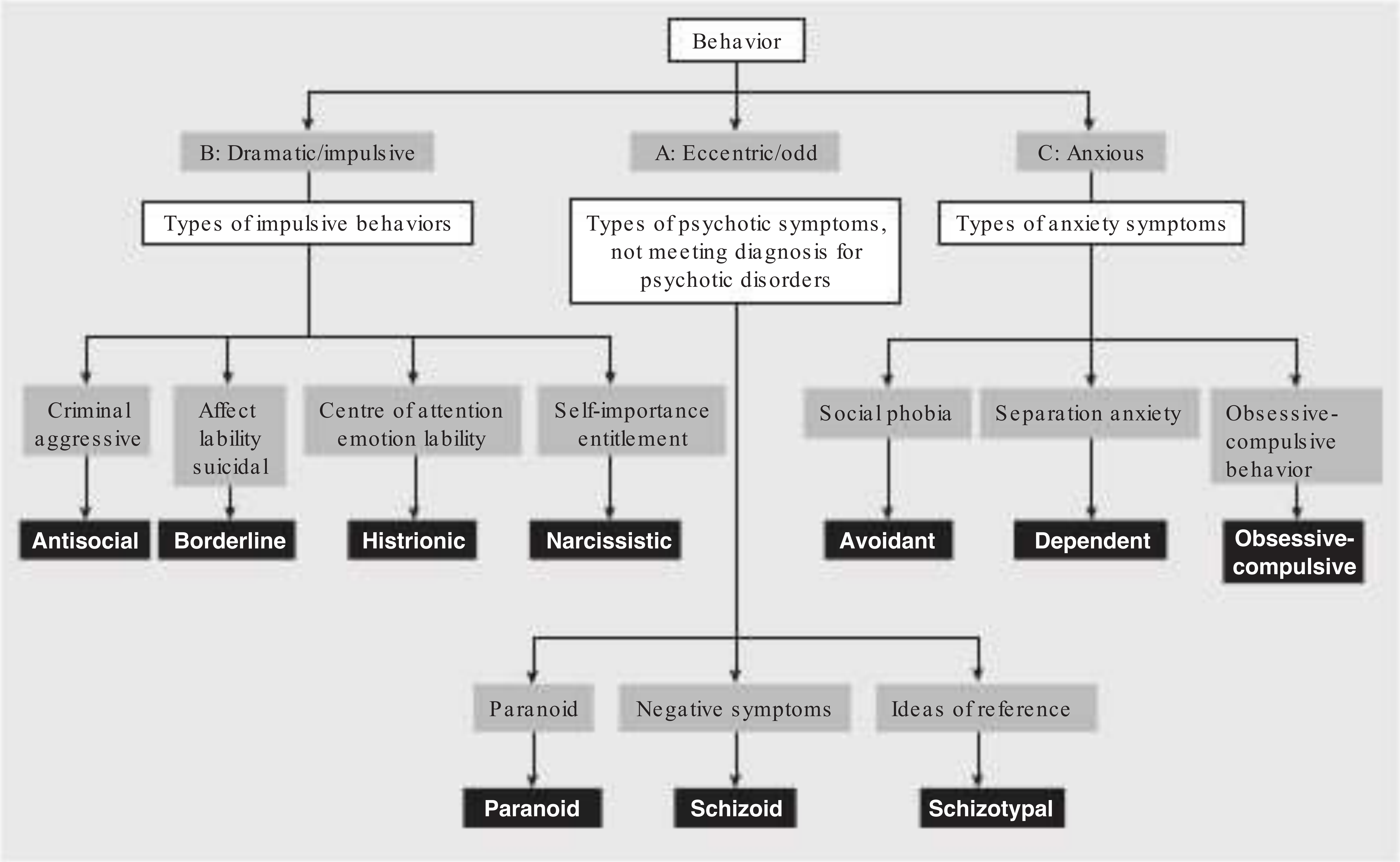


Figure 19.12. Personality disorders (DDx).

  - **T**: Takes pleasure in few activities
  - **A**: Appears indifferent from praises and criticisms
  - **R**: Restricts from close relationship
  - **Y**: Yanks himself or herself from social interactions
- Schizotypal PD (3%–5.6%) = ≥5 diagnostic criteria from "ME PECULIAR"
  - **M**: Magical thinking or odd beliefs
  - **E**: Experiences unusual perceptions
  - **P**: Paranoid ideation
  - **E**: Eccentric behavior or appearance
  - **C**: Constricted (or inappropriate) affect
  - **U**: Unusual (odd) thinking and speech
  - **L**: Lacks close friends
  - **I**: Ideas of reference
  - **A**: Anxiety in social situations
  - **R**: Rule out psychotic disorders and pervasive developmental disorder

Cluster B: Dramatic (Impulsive/Emotional) and "Bad"

- **Antisocial PD (3% in males; 1% in females) = ê3 diagnostic criteria from "CORRUPT"**
  - **C**: Conformity to law lacking
  - **O**: Obligations ignored
  - **R**: Reckless disregard for safety of self or others
  - **R**: Remorse lacking
  - **U**: Underhandedness (deceitful, lies, cons, others)
  - **P**: Planning deficit (impulsive)
  - **T**: Temper (irritable and aggressive)
- **Borderline PD (2%–4%) = ê5 diagnostic criteria from "AM SUICIDE"**
  - **A**: Abandonment
  - **M**: Mood instability
  - **S**: Suicidal and/or self-harming behaviors
  - **U**: Unstable and intense relationships
  - **I**: Impulsivity (self-damaging areas)

  - **C**: Can't control anger
  - **I**: Identity disturbance
  - **D**: Dissociative symptoms
  - **E:** Emptiness
- **Histrionic PD (1.3%–3%)** = **ê5 diagnostic criteria from "PRAISE ME"**
  - **P**: Provocative or sexually seductive behavior
  - **R**: Relationships considered more intimate than they are
  - **A**: Attention (uncomfortable when not the center of attention)
  - **I**: Influenced easily
  - **S**: Style of speech (impressionistic, lacks details)
  - **E**: Emotional liability and shallowness
  - **M**: Make up (physical appearance used to draw attention to self)
  - **E**: Exaggerated emotions (theatrical)
- **Narcissistic PD (2%)** = **ê5 diagnostic criteria from "SPECIAL"**
  - **S**: Special (believes he or she is special and unique), Status ("high")
  - **P**: Preoccupied with fantasies of unlimited success, power, brilliance, beauty, or ideal love
  - **E**: Entitlement (strong sense), Envious
  - **C**: Conceited (grandiose sense of self-importance)
  - **I**: Interpersonal exploitation
  - **A**: Arrogant (haughty)
  - **L**: Lacks empathy

Cluster C: Anxious and "Sad"

- **Avoidant PD (0.5%–1.6%)** = **ê4 diagnostic criteria from "AVOIDER"**
  - **A**: Avoid occupational activities
  - **V**: View self as inept, unappealing, or inferior
  - **O**: Occupies with fear of rejection or criticism in social situations
  - **I**: Inhibits from new interpersonal relationships
  - **D**: Difficulty initiating new projects due to lack of self-confidence
  - **E**: Embarrassment prevents new activity or taking personal risks.
  - **R**: Restraints in intimate relationships due to fear of being shamed
- **Dependent PD (1.6%–6.7%)** = **ê5 diagnostic criteria from "DEPENDENT"**
  - **D**: Difficulty in making everyday decisions without advice and reassurance from others
  - **E**: Excessive length to obtain nurturance and support
  - **P**: Preoccupies with thoughts of taking care of self
  - **E**: Exaggerated fears of being left to care for self
  - **N**: Needs others to assume responsibility for most major areas of his or her life
  - **D**: Difficulty in expressing disagreement
  - **E**: Ending one relationship immediately and seeking urgently for another
  - **N**: Not able to initiate projects due to lack of self-confidence
  - **T**: Take care of me is his or her motto
- **Obsessive-compulsive PD (3%–10%)** = **ê4 diagnostic criteria from "LAW FIRMS"**
  - **L**: Loses point of activity due to preoccupation with details
  - **A**: Ability to complete tasks compromised by perfectionism
  - **W**: Worthless objects unable to discard
  - **F**: Friendships and leisure activities excluded due to a preoccupation with work
  - **I**: Inflexible, scrupulous, overly conscientious on ethics, values, or morality, not accounted for by religion or culture
  - **R**: Reluctant to delegate unless others submit to exact guidelines
  - **M**: Miserly toward self and others
  - **S**: Stubbornness and rigidity

APPROACH

History

- History of presenting illness
  - Onset (often starts in young adults)
  - Symptoms
  - Duration (long-standing vs. intermittent)
  - Other mood or psychotic symptoms
  - Substance use
  - Eating disorder, self-harm
  - Interpersonal stressors

CLINICAL box

differentiating from Other Psychiatric disorders

- Onset: early onset (late adolescent to early adulthood)
- Duration: chronic for life, long-enduring patterns of behavior
- Natural history: nonepisodic, nonfluctuating
- Functioning: pervasive across all functioning in life, affecting social, occupational, and interpersonal functioning
- Insight: usually little because the disorder is egosyntonic (i.e., they have no concerns with the symptoms)
- Avoid medications that can be abused (benzodiazepines, opioids) or can be fatal in overdose (TCA)

- Social history
  - Early attachments
  - Living arrangements
  - Relationships
  - Educations
  - Trauma
  - Level of functioning
- Assess for degree of impairment and functioning

Physical Exam

- Neurologic exam
- Look for signs of self-harm (cuts, burns, etc.)

Mental Status Exam

- Grooming, tattoos, style of clothing, behavior during assessment, labile mood or unstable affect, fixed patterns or beliefs, thought patterns, grandiosity, paranoia, psychotic symptoms

Investigations

- Only needed if the clinician is seriously concerned about ruling out symptoms of another medical condition
- Routine blood work: CBC + differentials, thyroid function test (TSH, T_3/T_4), electrolytes, magnesium, calcium, phosphates, renal function test (creatinine, BUN), fasting glucose, Hb_{A1c}, liver function test (AST, ALT, ALP, albumin, INR, bilirubin), lipid profiles (LDL, HDL, TG), ESR, folate, vitamin B_{12}
- Urine drug screen
- Additional screening: neurologic consultation, CXR, ECG, EEG, CT/MRI of head
- CT head should be considered if there has been an abrupt change in pattern of behavior.

Management

- PDs improve at much faster rate with psychotherapy compared with the natural course of illness.
- Psychoeducation
- Psychotherapies (Table 19.16)
- DBT (especially for borderline PD)
- Social skills training (for schizotypal and dependent PD)
- Substances and alcohol abuse counseling (for antisocial PD)
- Pharmacotherapy: low-dose antipsychotics (for schizotypal and borderline PD), low-dose antidepressants, low-dose anxiolytics. **Note:** medications are treating clinical symptoms, not the PD.

TablE 19.16 • Psychotherapies

Brief therapy	Emphasizes on a specific problem with direct intervention
CBT	Modifies cognitions, assumptions, beliefs, and behaviors, with the aim of influencing disturbed emotions; with behavioral component including systemic desensitization, flooding, positive reinforcement, negative reinforcement, extinction, and punishment; and with cognitive component including theory, goal setting, and thought record
DBT	One of the best researched therapies for one of the most common PDs (borderline PD). It focuses on four areas: mindfulness, emotional regulation, interpersonal effectiveness, and distress tolerance. There are two components of the therapy: individual and group component. DBT is longer than most other manual-based therapies (> 1 yr)
Family/couple therapy	Works with families and couples in intimate relationships to nurture change and development with structural focus of here and now by reestablishing parental authority, strengthening normal boundaries, rearranging alliances, and emphasizing family relationships as an important factor in psychological health
Group therapy	Develops goals of self-understanding, self-acceptance, increasing social skills, and creating a microcosm of society
Insight-oriented therapy	Involves intensive analysis of the unconscious aspects of psychology, emotions, and behaviors, exploring the inner conflicts caused by childhood loss or trauma, providing understanding and insight into ways of dealing with loss and conflict, and developing more appropriate coping mechanisms

(continued)

Table 19.16 • (continued)

Brief therapy	Emphasizes on a specific problem with direct intervention
IPT	Brief psychological treatment for depression to improve the quality of the patient's relationships, to focus on unresolved grief and conflicts in his or her life that differ from his or her expectations, and to overcome social isolation
Psychodynamic psychotherapy	Interpersonal and relational intervention used to help patients in problems of living, increasing individual sense of well-being, and reducing subjective discomforting experience; based on experiential relationship building, dialogue, communication, and behavior change are designed to improve the patient's mental health
Group therapy	Develops goals of self-understanding, self-acceptance, increasing social skills, and creating a microcosm of society

SLEEP DISORDERS

MCC OBJECTIVE

Based on Objective #98 (Sleep-Wake Disorders) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- **Excessive daytime sleepiness** is a symptom of sleep disorders, where the patient has trouble staying awake and alert during the day and may sleep unintentionally and/or inappropriately on a daily basis for at least 3 mo. It is an indication for a more thorough evaluation for other sleep disorders:
  - Sleep-related breathing disorders include central and obstructive sleep apnea, and sleep-related hypoventilation—which are all characterized by abnormal respiration during sleep.
  - When the sleep–wake cycle is not in sync with the environment, such as the case with shift work or jet lag, or when the sleep phase is delayed or advanced, there may be circadian sleep disorders.
  - Parasomnias refer to undesired movements during sleep, and they could be non-rapid eye movement or rapid eye movement related.
- **Insomnia disorder** is characterized by difficulty with initiating or maintaining sleep, or where there is poor sleep quality at least 3 nights/wk for at least 3 mo, and causes significant distress or impairment, and the insomnia is **not better accounted for by another sleep disorder.** While tiredness and fatigue may be associated with insomnia disorder, excessive daytime sleepiness is not.

CAUSAL CONDITIONS (Figure 19.13)

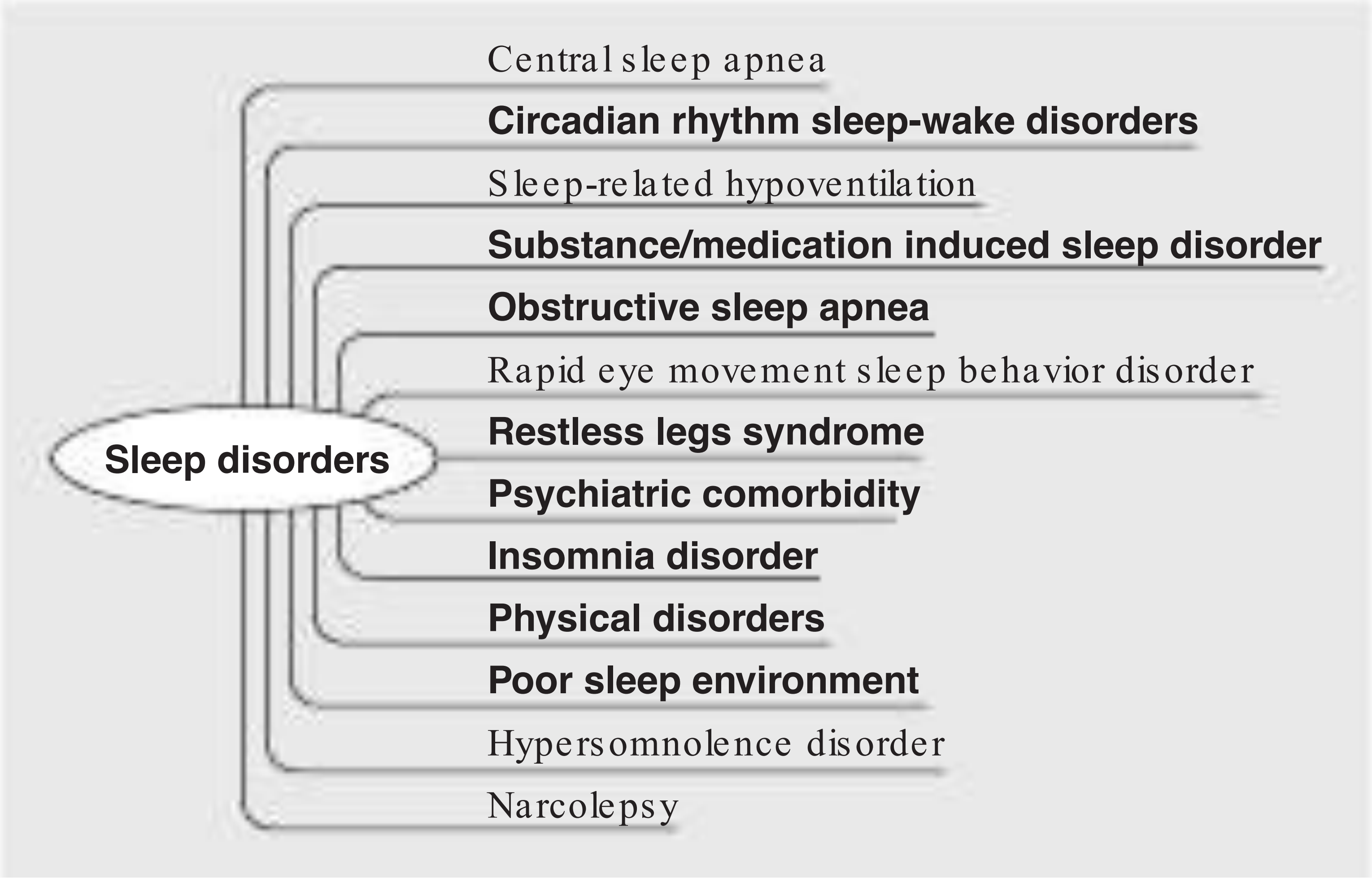


Figure 19.13. DDx of sleep disorders. This is not an exhaustive list. Causal conditions listed in the Objectives for the Qualifying Examination, 3rd Edition are in bold print.

APPROACH

History

- Conduct a thorough sleep history, use a sleep log
- Obtain collateral history: ask about loud snoring, parasomnias, witnessed apneas
- **Differentiate excessive daytime sleepiness from fatigue**
  - Excessive daytime sleepiness is the inability to stay alert at daytime. There may be inappropriate daytime sleeping (e.g., nodding off while driving).
  - Fatigue is a subjective lack of energy to perform mental or physical tasks.
- Screen for safety concerns related to excessive daytime somnolence (e.g., driving, heavy machinery)
- "**STOP BANG**" screen for obstructive sleep apnea: **s**noring, **t**ired, **o**bserved apneas, blood **p**ressure, **B**MI over 35 kg/m, **a**ge over 60 yr, **n**eck circumference over 40 cm, male **g**ender. High risk if yes to three or more items.
- Medical history, medications, substance use, over-the-counter products, caffeine intake
- Screen for psychiatric comorbidity such as depression
- Medical review of systems

General Observation and Physical exam

- Patients may yawn, fall asleep in the clinic.
- Perform vital signs, obtain BMI, inspection of neck and airway, and perform cardiopulmonary physical exam
  - Patients with obstructive sleep apnea may have obesity, large neck circumference, and hypertension.
- Often, patients with excessive daytime sleepiness will not show specific physical exam findings.

Investigations

- Polysomnography is recommended for patients with excessive daytime sleepiness when there is suspicion for obstructive sleep apnea, periodic limb movement disorder, sleep-related breathing disorders, narcolepsy, central hypersomnias, and seizures during sleep.
- Polysomnography can also be used to assess for central sleep apnea, periodic leg movement disorder, and narcolepsy.
- Home sleep apnea testing may be used for patients with a high suspicion for obstructive sleep apnea when there are no complicating medical conditions and there is little suspicion for other sleep disorders.
- Multiple sleep latency testing can be performed in sleep laboratories to assess for narcolepsy or idiopathic hypersomnia.

Management

- Counsel the patient on the management of the sleep disorder, depending on the underlying cause
- Counsel the patient that excessive daytime sleeping is a safety risk for driving and operating machinery
- Be aware of provincial laws on reporting medical unfitness to drive
- Arrange for specialized testing as warranted (i.e., patients with excessive daytime sleepiness)
- Treat psychiatric comorbidity
- For patients with insomnia disorder (i.e., no excessive daytime sleepiness and no safety concerns), review sleep hygiene measures:
  - Avoid napping
  - Avoid stimulants
  - Exercise early in the day
  - Establish routine bedtimes
  - Associate bed with sleep—use the bed for only sleep and intimacy
- Medications for sleep are for short-term use, and may cause dependency and rebound insomnia on cessation of use.
- CBT may be recommended for insomnia disorder (but is contraindicated for other disorders such as uncontrolled obstructive sleep apnea).

FATIGUE

MCC OBJECTIVE

Based on Objective #33 (Fatigue) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Fatigue is defined as a state of extreme weariness.
- It is a symptom that is associated with many medical and psychiatric conditions.
- We will focus on medical, physical, and psychiatric conditions that present fatigue as the primary complaint and consider modifiable life changes that can contribute to decreasing overall fatigue.

APPLIED SCIENTIFIC CONCEPT

- It is thought that there are many causes of *fatigue that can easily be modified*. It is important to ask about things such as sleep disturbances and lifestyle issues as causes of fatigue if no other cause can be found.

CAUSAL CONDITION (Figure 19.14)

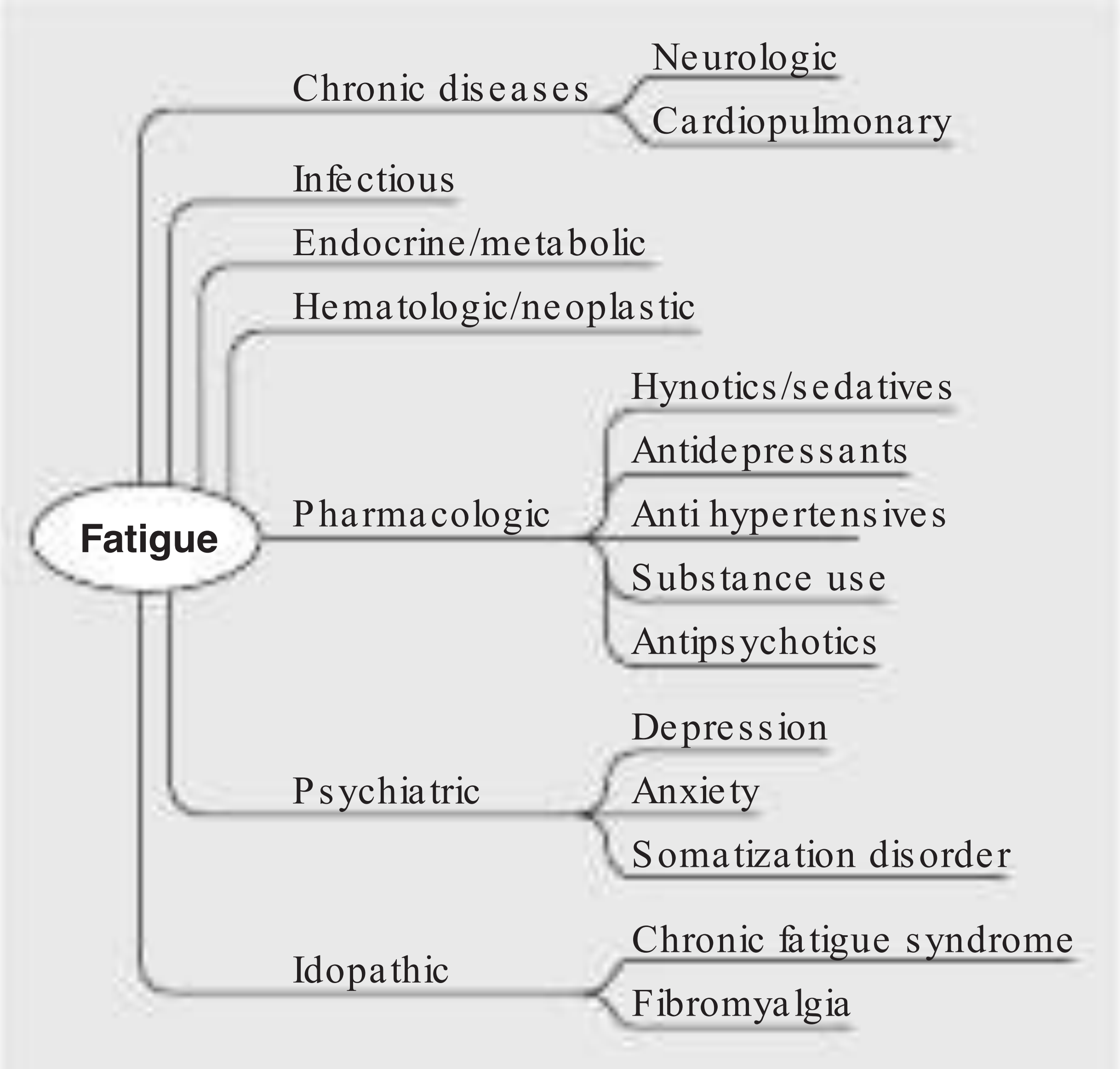


Figure 19.14. DDx of fatigue. Causal conditions listed in the *Objectives for the Qualifying Examination*, 3rd edition, are shown in the diagram.

APPROACH

History and Physical exam

- It is important to do a complete history and physical exam with a presentation of fatigue.
- Be sure to compile a list of medications that a patient is taking during the initial visit, as this may be the main cause of fatigue
- Do not forget to ask about sleep disturbances and lifestyle issues

Investigations

- The following investigations can be performed at the initial visit: CBC, electrolytes, renal function tests, liver function tests, thyroid function tests, fasting plasma glucose, lipid panel, and testing for syphilis and HIV. These may be repeated as indicated clinically.
- Other, more focused investigations may be indicated according to your history and physical exam.

diagnosis

- This may be a working Dx after the history, physical exam, and initial investigations.

- If there is an easily modifiable cause for fatigue, you can ask/suggest the patient to work on that cause first before investigating further.
- Be sure to consider fatigue as a symptom within another *DSM-5* Dx such as:
  - MDD
  - Generalized anxiety disorder
  - Caffeine withdrawal
  - Stimulant withdrawal

Management

- The management principle is to treat the underlying cause of fatigue.
- As mentioned previously, this may be a stepwise approach in modifying the easily modifiable agents first (i.e., iron-deficient anemia) and then working on the more difficult causes of fatigue (i.e., chronic disease).

ADULT ABUSE / INTIMATE PARTNER ABUSE

MCC OBjECTIvE

Based on Objective #114-3 (Adult Abuse/Intimate Partner Abuse) of *Objectives for the Qualifying Examination*, 3rd edition.

OvERvIEw

- **Domestic violence** = intentional controlling or violent behavior (physical, sexual, or emotional abuse, economic control, or social isolation of the victim) by a person who is/was in an intimate relationship with the victim
- The victim lives in a state of constant fear and is terrified about when the next episode of abuse will occur.
- Despite this, abuse frequently remains hidden and undiagnosed because patients often conceal that they are in abusive relationships.
- Abuse of power in a relationship involving domination, coercion, intimidation, and the victimization of one person by another
- Most spouse abuse: wife abuse (some abuse of husbands has been reported)
- 10% of women in a relationship with a man have experienced abuse.
- Of women presenting to a primary care clinic, almost one-third reported physical and verbal abuse.

Categories

Physical

Pushing, hitting, biting, burning, locking out, abandoning in an unsafe place; resulting in pain, injury, sleep deprivation, disablement, and murder

Sexual

Forced unwanted sexual activity such as rape; sex with objects, friends, or animals. May also include demands to wear more provocative clothing, etc.

- Rape of wives
- Rape of women (may be associated with other crimes or nonsexual abuse)
- Sexual sadists
- Exploitive predators
- Men dealing with feelings of inadequacy
- Men with displaced expression of anger and rage

Emotional or Psychological

Constant criticism; threats to hurt, kill; extreme jealousy, denying friendships, outside interests, or activities; time accounting, etc.

Economic

Not allowing money, denying improvement in earning capacity, detailed accounting of spending, etc.

CAUSAL CONDITIONS

Preexisting vulnerabilities

- Women/pregnant (trauma victims, chronic abdominal pain/headaches)
- Elders with injuries
- Children with injuries

- Head injuries
- Others (past violence, former victim of abuse, intellectual functioning, family and cultural influences, impulsivity)

Psychiatric/Medical Disorders

- Psychosis (e.g., delusions of persecutory or jealous types, command hallucinations)
- Substance-related (e.g., abuse/dependence, intoxication, withdrawal, substance induced–psychotic/mood/anxiety/cognitive disorders)
- PD (e.g., antisocial, borderline, narcissistic, paranoid)
- Mood disorders (e.g., manic phase of BP, agitated depression)
- Cognitive disorders (e.g., delirium, dementia)
- Attention Deficits (ADs) (e.g., OCD, generalized AD, social phobia)
- Attention-deficit and disruptive behavior disorders (e.g., ADHD, oppositional defiant disorder, conduct disorder)
- Pervasive developmental disorders/autistic spectrum disorders
- Developmental disability/mental retardation
- Impulse control disorders (e.g., intermittent explosive disorder)
- Medication-induced (e.g., akathisia)
- Other General Medical Condition (GMC) related (e.g., Huntington, neuropsychiatric SLE)
- Socioeconomic cultural factors
- Chronic medical conditions/disability

APPr OACH

- History of hyperalertness, sleeping or eating disturbances, fatigue, mood swings, phobias, somatization, exaggerated startle response
- Past experiences of sexual assault, family violence, or child sexual abuse

General Observations and Physical exam

- Partner refuses to leave exam room and answers questions for the patients.
- Signs of imminent violence in partner: threats, paranoid ideas, yelling, pacing, agitated behavior
- Mental status exam: avoidance of eye contact/ fearfulness, evasive behavior, hostility, appears in distress/ psychomotor retardation, agitation (fidgeting, moving about, hand-wringing, nail biting, hair pulling, lip biting), restlessness/ depressed mood and flat restricted effect/ suicidal and or homicidal ideation, intent, plan
- Examine vital signs (tachycardia), pupils (drug-related), and skin for scars/wounds/ bruises, stigmata of drug and/or alcohol use, and weight loss (chronic suffering)
- Examine location of injuries (usually central, breasts, abdomen, genitals), forearm defensive wounds, bruises of different ages

Investigations (Table 19.17)

tAbl e 19.17 • Investigations in violence

Test	Finding/Interpretation
CBC	To rule out anemia and/or infection
Electrolytes	To rule out electrolyte imbalance, dehydration, starvation
Thyroid (TSH)	To rule out hyper- or hypothyroidism
INR, PTT, coagulation status	To rule out coagulopathy
Toxicology/drug screen	• Alcohol • Cannabis • Opioid • Amphetamine • Cocaine • Other stimulants
Urinalysis	Drugs (see above)
CXR	To rule out fractures
Other x-ray	To rule out limb fractures
CT	Headache to rule out brain lesions, masses, or hemorrhage

Management

- Determine immediate and short-term risk to victim
- Provide validation, support, and counseling
- Offer referral (e.g., hospital social worker, local domestic hotline, domestic violence advocates, institutional and community resources, specialists such as psychiatrists) to discuss options and safety issues and plans
- Educate patient about what to do in case of emergency and range of support services available
- Leave the room and obtain assistance from security or police if partner is violent
- Physician's legal responsibility to report potential victims of violent patients only with patient's consent because of patient–physician confidentiality
- Diagnose wife/husband abuse and assess the role in etiology of other health concerns; assess immediate and short-term risk to victim
- Determine whether the husband/wife comes from a violent home or was abused himself or herself, feels threatened at home, work, or with peers

Physician must report to CAS or other related society if family violence involves children.

ELDER ABUSE

MCC OBJECTIVE

Based on Objective #114-2 (Elder Abuse) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- An act or omission that results in harm to the elderly person's health or welfare
- Types of abuse: physical, emotional, sexual, economic, and neglect (Table 19.18)

TABLE 19.18 • Categories of elderly abuse

Physical	Pushing, hitting, biting, burning, locking out of home, abandoning in an unsafe place
Sexual	Forced unwanted sexual activity: rape, sex with objects, friends, animals, mimic pornography, wear more provocative clothes, etc.
Emotional or psychological	Constant criticism, threats to hurt, kill, extreme jealousy; denying friendships, outside interests, or activities; time accounting, etc.
Economic	Not allowing money, denying improvement in earning capacity, taking money out of account, etc.
Abandonment, neglect, and self-neglect	

CAUSAL CONDITIONS/RISK FACTORS

- See Elder Abuse section in Chapter 9: Geriatrics
- Must rule out GMCs

General Observations and Physical Exam

- Observe for distress, agitation, restlessness, and affect
- Examine for bruises, bites, burns, lacerations, and other injuries

Investigations

- Dementia workup (see Dementia section in Chapter 9: Geriatrics)

Management

- Decide whether hospitalization is necessary or alternative accommodation (if there is concern for patient safety)
- Legal implications of elderly abuse might include police involvement and law.
- Counsel and assist caregiver; provide information and education in accessing community services
- Multidisciplinary approach to intervention
- See Family Violence section in Chapter 8: General Surgery for further details

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Chapter

20

Public Health

Amandeep Sheny Khera • Lisa J. Steblecki • Fraser Brenneis

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Periodic Health Exam
Health Status Assessment and Measurement
Population Health and Its Determinants
Work-Related Health
Outbreak Management
Environment

PERIODIC HEALTH EXAM

MCC OBJECTIVE

Based on Objective #74 (Periodic Health Examinations [PHE]) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Patients present when they are asymptomatic in hope of discovering disease in the early stages or in order to prevent disease all together. It is an excellent opportunity for the physician to emphasize preventative medicine.

Child Age 0 to 3 Yr

At Risk for
SIDS (<1 yr), FTT, developmental delay

Screening Questions/Measurements
Height, weight, head circumference, birth Hx/pregnancy Hx, diet Hx, developmental milestones, family Hx

Lab Work/Test
TSH, PKU at birth
Some provinces include screening for other metabolic D/O.

Strong Evidence to Recommend/Discuss
Immunization, back to sleep, home safety, smoke-free environment, dental health

Child Age 3 to 12 Yr

At Risk for
Developmental delay, accidents/trauma, visual/hearing loss, obesity

Screening Questions/Measurements
BP, nutrition Hx, physical activity Hx, developmental milestones

Lab Work/Testing
As needed

Strong Evidence to Recommend/Discuss
Home safety, nutrition, dental health, immunization

Adolescent Age 13 to 24 Yr

At Risk for
MVA, substance abuse, STI, obesity, eating disorders

CLINICAL box

HEEADSS: Periodic Health Exam

- Home—with who, safe
- Education—grade, academic success, behavior/punishment
- Employment—what, do they need, the wage/supporting self
- Activities—risky behavior, sports, peer group
- Drugs—types, amount, time period
- Suicide—mood, self-esteem
- Sex—with who, activities, safety

Screening/Measurements

BP, nutrition Hx, physical activity Hx, HEEADSS (see Clinical Box)

Lab Work

Pap test (as appropriate), discussion of HPV vaccination, and STI as necessary

Strong Evidence to Recommend/Discuss

Condoms, contraception, avoid risky behavior, seat belts, body image, dental health, immunization

Adult Age 24 to 44 Yr

At Risk for

Cancer, IHD, substance abuse, eating disorders, HTN, incontinence

Screening/Measurements

BP, Psych Hx, social Hx, Medical Hx, current symptoms, depression screen

Lab Work/Imaging

Mammography (50–69 q1–2yr), Pap (as appropriate), fasting lipids (men >40 and women postmenopausal or >50 or any age with risk factors q1–3yr), fasting glucose (>40 q3yr or more frequent if risk factors)

Strong Evidence to Recommend/Discuss

Folic acid if planning pregnancy, smoking cessation, dental health, immunization

Adult Age 45 to 64 Yr

At Risk for

Cancer, IHD, substance abuse, obesity, osteoporosis, HTN, incontinence

Screening/Measurements

BP, Psych Hx, social Hx, Medical Hx, current symptoms

Lab Work/Imaging

FOBT (start age 50 q1–2yr), mammogram (50–69 q1–2yr), Pap test, discuss DRE and PSA, bone density (if risk factors for osteoporosis, previous fracture, or over age 65 q3–5yr)

Strong Evidence to Recommend/Discuss

Smoking cessation, dental health, Ca^{2+} and Vit D (postmenopausal women), physical activity, heart healthy diet, immunization

Adult Age 45 to 64 Yr

At Risk for

Falls, polypharmacy, IHD, cancer, visual/hearing loss, incontinence

Screening/Measurements

MMSE if suspect cognitive decline

Lab Work/Imaging

FOBT (start age 50 q1–2yr), mammogram (yearly 50–69 yr), Pap test, discuss DRE and PSA, bone density (if risk factors for osteoporosis, previous fracture, or over age 65 q3–5yr)

Strong Evidence to Recommend/Discuss

Smoking cessation, dental health, Ca^{2+} and Vit D (postmenopausal women), physical activity, heart healthy diet, immunization

Over 65 Yr

At Risk for

Falls, polypharmacy, IHD, cancer, visual/hearing loss, incontinence

Screening/Measurements

MMSE if suspect cognitive decline

Lab Work/Imaging

FOB (start age 50 q1–2yr), mammogram (yearly 50–69 yr), Pap test, discuss DRE and PSA, bone density (if risk factors for osteoporosis, previous fracture, or over age 65 q3–5yr)

Strong Evidence to Recommend/Discuss

Smoking cessation, dental health, Ca^{2+} and Vit D (postmenopausal women), physical activity, heart healthy diet, immunization

CLINICAL box

Use of the Periodic Health Exam

Periodic health exams are no longer encouraged to be overly exhaustive. The physician should focus on and order investigations based on the likelihood of finding an abnormality. This is also the case for the physical exam.

CAUSAL CONDITIONS (Table 20.1)

TABLE 20.1 • Consideration of select special populations

	Causal Factors			
Population	Social Environment	Genetics	Physical Environment	Common Diagnoses
People with disabilities	Finances Education/mental capacity Access to health care Community/social supports Caregiver abuse	Down syndrome	Modified environment to accommodate special needs Work conditions Geographic location (rural, urban)	Pressure sores Depression Muscle atrophy Obesity Falls Substance abuse Malnourishment Abuse
Children in poverty	Poverty Education Parental support Access to health care Community support Family violence		Geography (safety of neighborhood, homeless) Smoke Clean drinking water and nutritious food	Trauma Poisoning SIDS Low birth weight Infection Substance abuse Child abuse Asthma FIT Psychiatric disorder Poor detention
Aboriginal populations	Poverty Education Access to health care Family violence Tobacco use		Housing (reservation/homeless) Northern/isolated community Lack of clean drinking water and nutritious food	Trauma Poisoning SIDS Malignancy COPD Otitis media TB Hepatitis/cirrhosis HIV Suicide/depression Substance abuse Diabetes
Elderly population	Finances Community/social support Access to health care Caregiver abuse		Housing (independent, assisted) Modified for individual's needs Geographic location (rural, urban)	Falls Arthritis Heart disease Resp disease (COPD, ISLD) Dementia Abuse Incontinence FIT Malignancy PVD Visual/hearing loss Depression Malnourishment Diabetes

HEALTH STATUS ASSESSMENT AND MEASUREMENT

MCC OBJECTIVE

Based on Objective #78-2 (Assessing and Measuring Health Status at the Population Level) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

The interventions and programs designed to create and promote health in a particular community can be evaluated to ensure that the needs of the community are being met. The health status of a community can also be measured in order to decide which interventions are needed.

APPLIED SCIENTIFIC CONCEPTS

Mortality Rates

$$\textbf{Infant} = \frac{\text{\# Deaths in children} < 1 \text{ yr in a certain time period and population}}{\text{\# Live births in that same period and population}}$$

- **Neonatal:** change numerator to # deaths in children <28 d old
- **Perinatal**: change numerator to # deaths in fetuses >28 wk GA + infants <7 d old

$$\textbf{Maternal} = \frac{\text{\# Deaths related to a puerperal cause in a certain time period and population}}{\text{\# Pregnancies in the same time period and population}}$$

$$\textbf{Proportionate mortality ratio} = \frac{\text{\# Deaths due to a particular cause}}{\text{Total \# deaths in the same time period and population}}$$

$$\textbf{Crude death rate} = \frac{\text{\# Deaths in population from any cause}}{\text{Total population in that same period}}$$

$$\textbf{Age-specific death rate} = \frac{\text{\# Deaths in an age-group in a certain time period and population}}{\text{Average or mid-year population of that age-group in the same time period and population}}$$

$$\textbf{Case fatality rate} = \frac{\text{\# Deaths from illness in a certain time period}}{\text{\# People diagnosed with that illness in that time period}}$$

Potential Years of Life Lost

$$\textbf{PYLL} = \text{Life expectancy for population} - \text{Age at death of individual}$$

$$\textbf{For population PYLL} = \frac{\text{Add all PYLL for all members who died}}{\text{Total \# members of population under the age of life expectancy}}$$

Screening Tests

Disease should be:

- Relatively common
- Seriously morbidity and/or mortality
- Treatment available/prognosis improved with early detection

Test should be:

- Safe
- Cost effective
- Specific and sensitive
- Reliable and valid

A screening test is not a diagnostic test.

CLINICAL box

Definition of Common Terms

Valid—does it measure what it claims to?

Reliable—can it be repeated and the same result obtained?

Predictive value—the probability that a positive test is a true positive case or that a negative test is a true negative case; determined by the sensitivity and specificity and prevalence of the tested condition

Efficacy—the ability to produce a specific result

Efficient—is the output useful and worth the input?

Compliance—did someone do as instructed?

Incidence—the # new cases that will occur in a certain time period

Prevalence—the # cases present at a particular time

Sensitivity and Specificity (Table 20.2)

TABLE 20.2 • 2 × 2 Table used to calculate sensitivity, specificity, and predictive value

	Disease Present	Disease Not Present
Positive test	A	B
Negative test	C	D

Sensitivity—if the condition is there, the probability the test will pick it up = $A/(A+C)$

Specificity—if the condition is not there, the probability the test result will be negative = $D/(B+D)$

Positive predictive value: $A/(A+B)$

Negative predictive value: $D/(C+D)$

General Rules for Evaluating Evidence

- Systematic reviews are better than an individual trial of the same kind.
- Randomized control trials are the best evidence when true randomization and allocation concealment are present.
- Ignore conclusions drawn from a trial that was designed to test something different (ignore secondary findings if study was not originally looking for them)
- Few studies will directly quote useful values. If possible, calculate them yourself to see if you feel the numbers match the conclusions given.
- Try to use EBM whenever possible, but there is not always research available to support our decisions.
- When advising patients about a screening test, consider incidence and prevalence of disease, specificity and sensitivity, safety, natural Hx of the disease, and resources available for diagnosis and treatment.
- When advising patients about a treatment, consider the efficacy, efficiency, and likelihood for compliance.

POPULATION HEALTH AND ITS DETERMINANTS

MCC OBJECTIVE

Based on Objective #78-1 (Concepts of Health and Its Determinants) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

The social and physical environments are just as important in defining the health of a population as genetics. It is important for the physicians to know the social and physical environments of the patient population they serve in order to provide more comprehensive care.

Overall Determinants of Health

- Biology
  - Genetics
- Behaviors
  - Coping skills
  - Diet
  - Exercise
  - Substance use
  - Use of medical services

- Physical environment
  - Geographic location
  - Peace
  - Housing
  - Work conditions
- Social environment
  - Employment income
  - Social status
  - Education
  - Culture
  - Religion
  - Health services
  - Support network
  - Family violence

Disease Prevention

In order to decide which preventative strategies/recommendations to make in a particular population, determine age of members, incidence of a disease, prevalence of a disease, and attack rate or create surveys to poll the population as to which behaviors/conditions are an issue (Tables 20.3 and 20.4).

TAbLE 20.3 • Preventative medicine

Ask All Patients About	What You May Learn That Allows for More Effective Preventative Medicine
Ethnic background and culture	Genetic predispositions Perceptions of disease/illness Willingness to seek medical services
Education	Level of medical knowledge How to effectively communicate
Occupation	Disease predispositions Economic means for health
Religion	Perceptions of disease/illness Which treatments/procedures a patient finds acceptable
Housing/living arrangements	Whether they are living in a safe environment Disease predispositions

TAbLE 20.4 • Disease prevention

Type of Prevention	Level of Action	Key Strategies for Prevention	Conditions Prevented
Primary	Before any disease is present	Education Social marketing Public health policy Community organizations	Family violence Outbreaks Many chronic medical conditions Accidental death
Secondary	Very early stages of diseases—allows for effective intervention	Education Social marketing Public health policy	Those for which an effective screening test is available
Tertiary	Disease established—treatment and minimize suffering	Education Social marketing Community organizations (support groups)	Hopefully morbidity and mortality reduced

WORK-RELATED HEALTH

MCC OBJECTIVE

Based on Objective #78-8 (Work-Related Health Issues) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

A patient's occupation plays a large role in his or her life. It is important for a physician to know a patient's occupational Hx in order to provide preventative and comprehensive care.

APPROACH

History (Table 20.5)

TABLE 20.5 • Common occupational exposures

Type of Exposure	Example	Protection	Occupations at Risk	Conditions to Think About	Tests
Inhalants	Volatile chemicals, CO, grain, mold/plant matter, asbestos, smoke, wood, metals	Resp mask Fume hood	Chemist Farmer Fireman Construction Welder Medical Lab Scientist	Asbestosis Mesothelioma Interstitial fibrosis Asthma Lung cancer	CXR
Skin contact	Chemicals Latex Radiation	Gloves Lead barriers Closed-toe shoes	Manufacturing X-ray technician Chemist	Contact dermatitis	Clinical diagnosis
Blood borne	Virus Bacteria	Gloves Universal precautions	Health care Prostitution Veterinarian	Hepatitis A, B, & C HIV Animal bites	Serology
Sound	Machinery Music	Ear plugs	Construction DJ Bartender	Tinnitus Hearing loss	Audiology
MSK	Heavy lifting Repetitive movements Prolonged sitting	Proper technique Rest	Hairdresser Dentist Assembly line	Low back pain Carpal tunnel Cervical strain	Clinical diagnosis

- What type of work do you do? In the past?
- What type of work activities?
- How long at each job?
- Wore protective gear?
- Current symptoms?
- How long have symptoms been present?
- Are symptoms different at work and home?
- Do you think it is related to your work?
- Anyone else at work with similar symptoms?

Management

- Thoroughly document work-related injuries/conditions
- Treatment should focus on removing the worker(s) from immediate danger, relieving immediate suffering, as well as returning function long-term
- Determine fitness to return to work
- Recommend preventative measures
- Remember you must obtain consent to release information to WCB or a patient's employer
- MSDS (Material Safety Data Sheets) can be obtained from OHS for particular exposures
- May warrant referral to an occupational health specialist

CLINICAL box

Hx for Workplace Injury

For workplaces involving chemicals, ask about:

- Products manufactured
- Heating sources
- Cleanup practices
- Protocol for handling hazardous substances
- Ventilation
- Protective garments

OUTBREAK MANAGEMENT

MCC OBJECTIVE

Based on Objective #78-5 (Outbreak Management) of *Objectives for the Qualifying Examination*, 3rd edition.

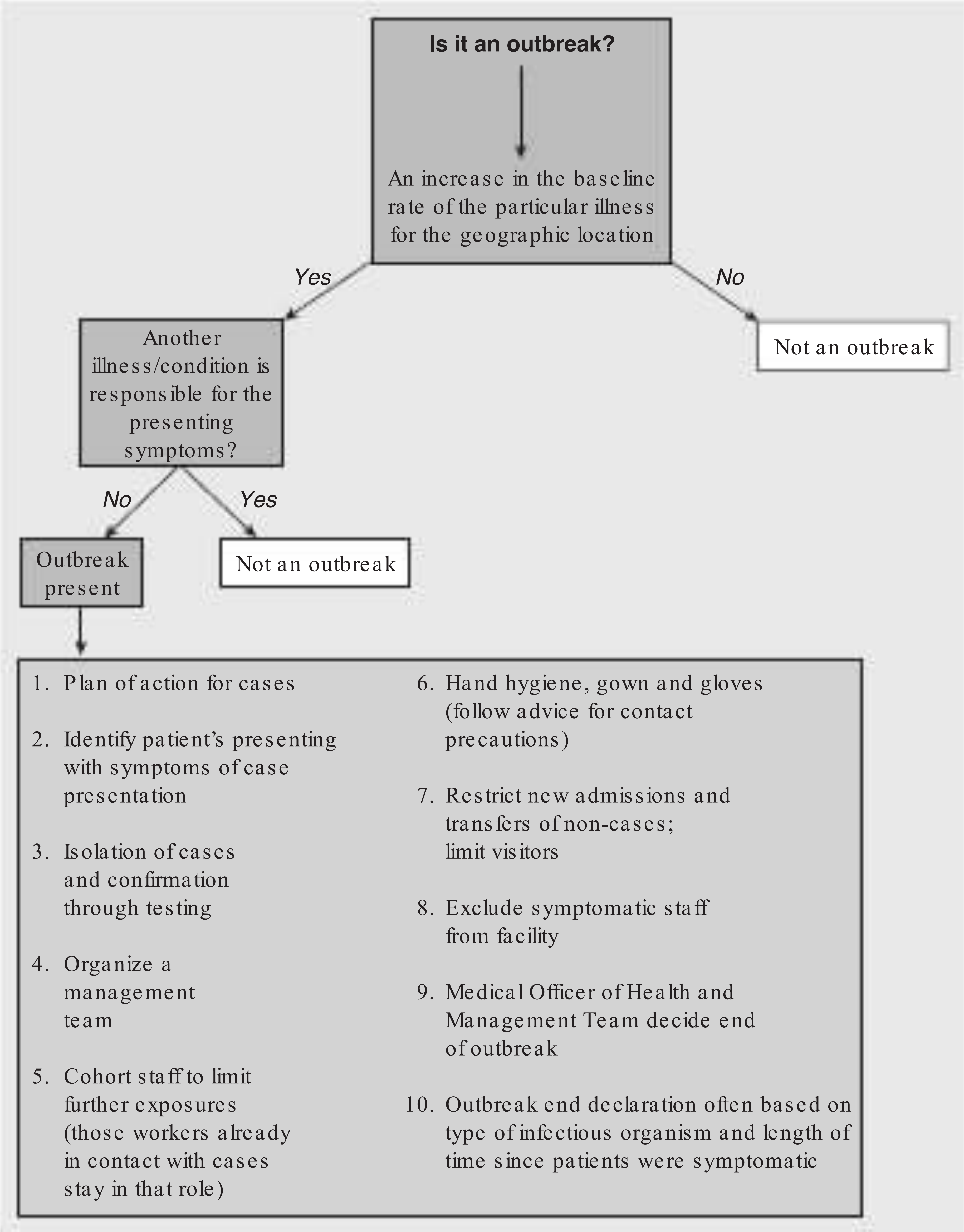
OVERVIEW

Physicians play a very large role in the control of an outbreak. They must be able to diagnose the condition, help limit the spread, and report to health authorities.

Outbreak: a greater than expected number of epidemiologically linked cases of a particular illness

Case definition: the specific criteria (symptoms, onset) required to label an individual suspicious for or actually infected with the illness in question; can initially be broad but becomes more defined over time

APPROACH (Figure 20.1)


Is it an outbreak?
An increase in the baseline rate of the particular illness for the geographic location
Yes
No
Not an outbreak
Another illness/condition is responsible for the presenting symptoms?
No
Yes
Outbreak present
Not an outbreak

1. Plan of action for cases
2. Identify patient's presenting with symptoms of case presentation
3. Isolation of cases and confirmation through testing
4. Organize a management team
5. Cohort staff to limit further exposures (those workers already in contact with cases stay in that role)
6. Hand hygiene, gown and gloves (follow advice for contact precautions)
7. Restrict new admissions and transfers of non-cases; limit visitors
8. Exclude symptomatic staff from facility
9. Medical Officer of Health and Management Team decide end of outbreak
10. Outbreak end declaration often based on type of infectious organism and length of time since patients were symptomatic

Figure 20.1. Approach to an outbreak.

CLINICAL box

Occupational Exposures

Always think how occupational exposures can be causing a condition in a particular patient with no typical risk factors. For example, the diagnosis of lung cancer in a nonsmoker.

CLINICAL box

Prescribing Medication

Always think about a patient's occupation when prescribing medication. For example, a medication that causes drowsiness can lead to a fatal mistake at work.

CLINICAL box

Outbreaks

An outbreak is not limited to only infectious agents. For example, environmental exposures can create an increased # cancers in a particular population.

CLINICAL box

Immunizations

Immunization is a major player in outbreak prevention of infectious agents. Important ones to know are measles, mumps, diphtheria, meningitis, and influenza.

Management

The Role of Public Health Can Include
- Education
- Immunization/prophylaxis strategies
- Advice for health centers
- Investigation of cause of outbreak (travel, food borne)
- Investigation of environments involved (restaurants)
- Communication with the public/media

ENVIRONMENT

MCC OBJECTIVE

Based on Objective #78-6 (Environment) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

The physical environment plays a large role in the development of illness in a population. By understanding the physical environment of a patient population, a physician can better provide preventative and comprehensive care.

CAUSAL CONDITIONS (Figure 20.2)

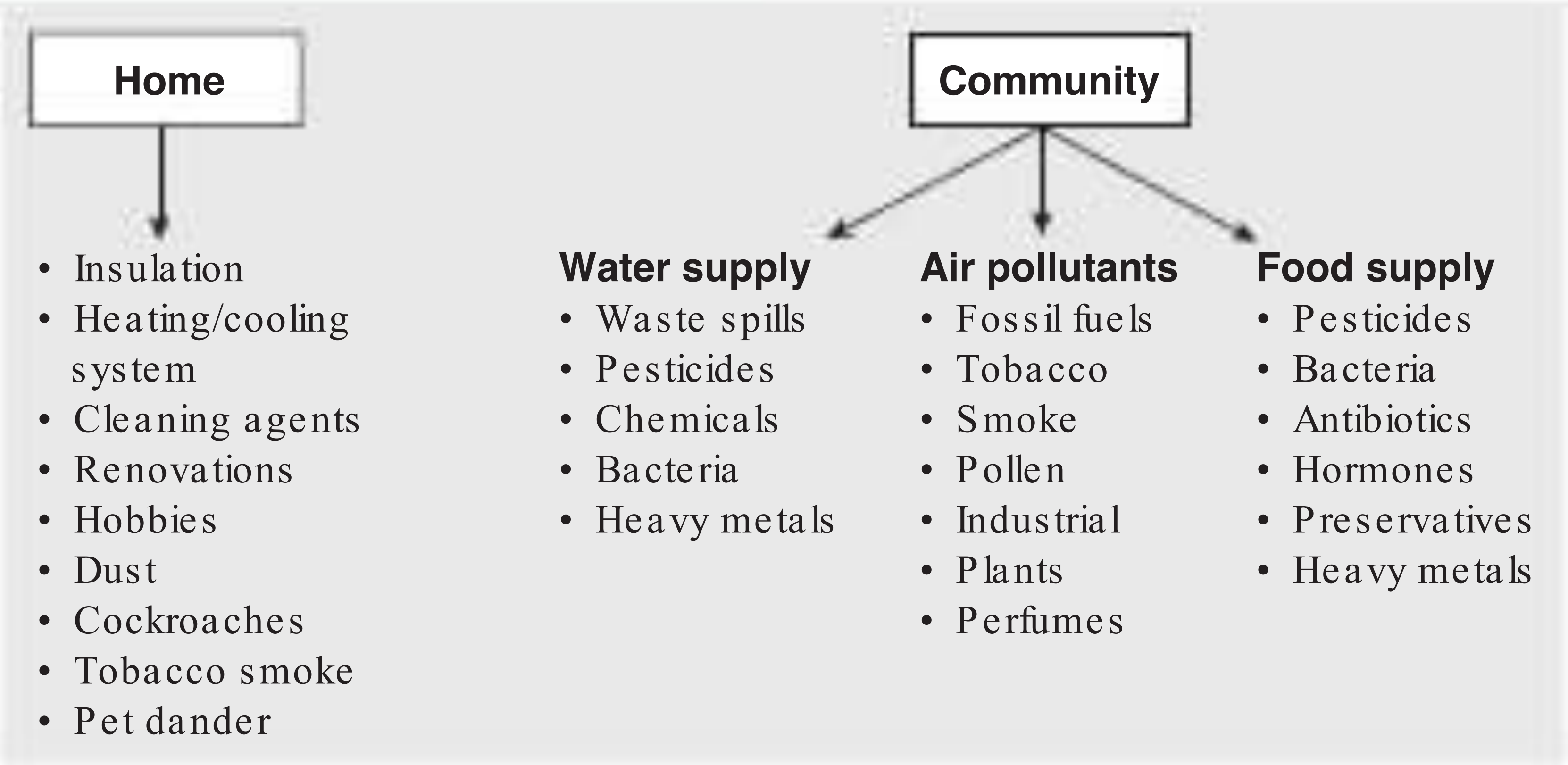


Figure 20.2. Environmental causal conditions.

APPROACH

History

- Type of symptoms (Table 20.6)

TABLE 20.6 • Symptoms of environmental exposure

Common Symptoms	Exposures to Think about
Headaches	Sick building syndrome CO, SO_2 Perfumes Paint/varnishes
Dermatitis	Chemicals (laundry detergents, cleaning agents) Radiation (UV, x-ray) Metals (nickel)
SOB/cough	Tobacco smoke, fertilizers, asbestos, pollen
Vomiting/diarrhea	Bacteria or chemicals in food Heavy metals

- Onset of symptoms
- Relation to work, home, hobbies
- Occurrence after known exposure
- Time to develop after exposure
- Time to resolve after exposure removal
- Progression/frequency of symptoms over time
- Occupational Hx
- Rural or urban home

Note: think about possible exposures from the flow chart above

Investigations (Table 20.7)

TAbLE 20.7 • Investigation of select environmental exposures

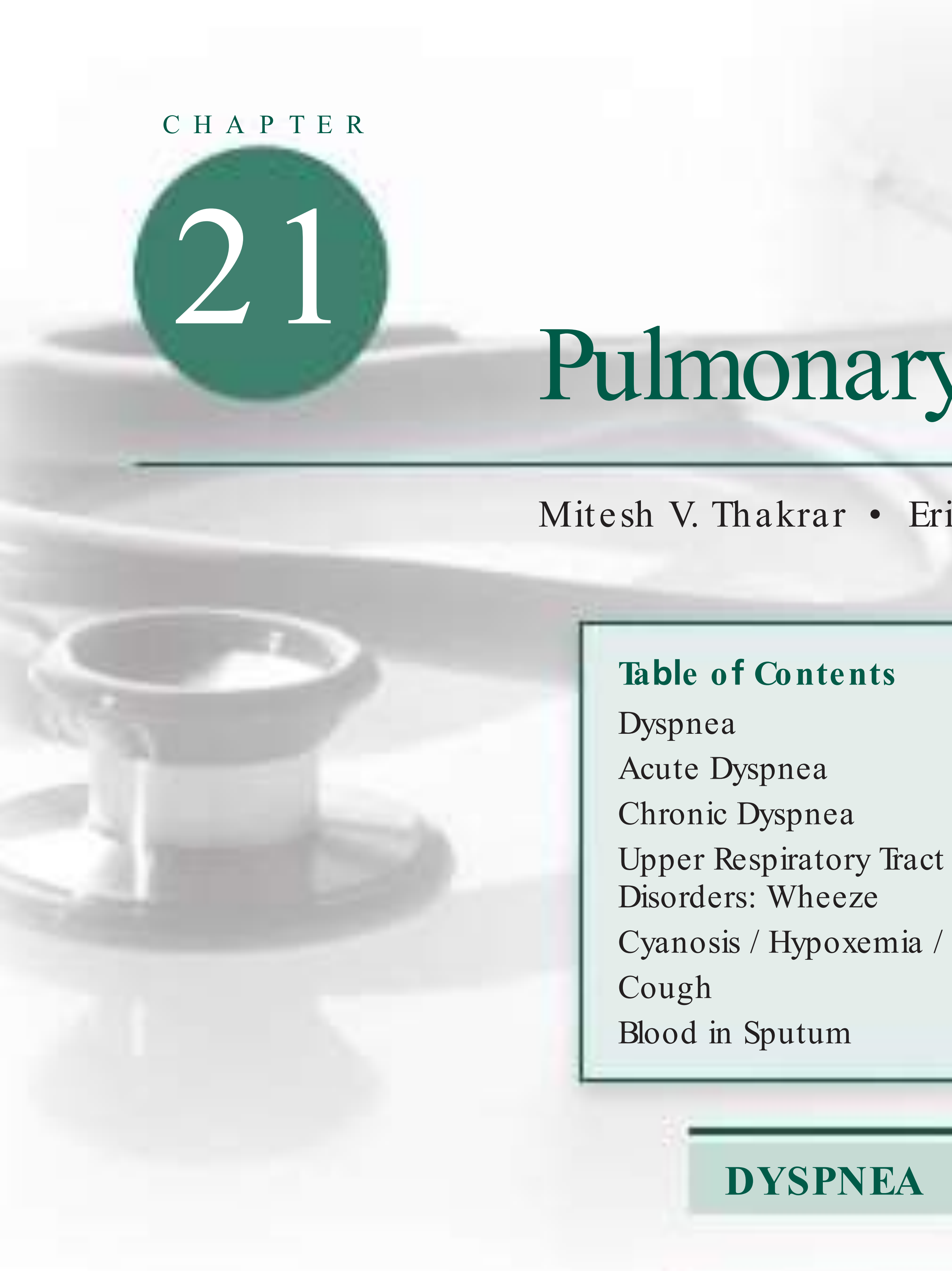
Exposure	Symptom	Tests and Treatment	Complications
Lead	Nausea, GI upset, headache, seizures, irritability, Burton line	Lead blood level Chelation therapy	Coma Learning disability
CO	Fatigue, headaches, palpitations, SOB, confusion	CO Hbg level EKG Creatinine Hyperbaric O_2	Arrhythmias MI ARF Cardiac/Resp arrest Cognitive difficulties Muscle necrosis

Authorities may have to be contacted to have an environment inspected and to eliminate other exposures.

CLINICAL box

References for Environmental Toxins

When symptoms are suspected to be due to an environmental cause, further information can be obtained from MSDS, toxicologists, government agencies, or poison control centers.



CHAPTER

21

Pulmonary Medicine

Mitesh V. Thakrar • Erika D. Penz • Rhea Varughese • Brandie L. Walker

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Dyspnea
Acute Dyspnea
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Asthma
Pleural Effusion / Pleural Abnormalities
Pneumothorax
Unilateral / Local Edema
Respiratory Allergy

DYSPNEA

MCC ObjECTivE

Based on Objective #27 (Dyspnea) of *Objectives for the Qualifying Examination*, 3rd edition.

OvErviEw (Table 21.1)

TAblE 21.1 • Resp states

Dyspnea	• Subjective experience of shortness of breath • Common with both pulmonary and cardiac dz
Tachypnea	↑ Rate of breathing (> 20 breaths/min)
Hyperpnea	Deep and rapid breathing
Hyperventilation	An ↑ in alveolar ventilation, leading to an alveolar CO_2 level below normal

APPliED SCiENTifiC CONCEPTS

- Respiration is controlled in the medulla with inputs from:
  - Cortical (voluntary) control
  - Mechanical/stretch receptors in chest wall and diaphragm
  - P_{CO_2}/pH chemoreceptors in the medulla
  - P_{CO_2}, P_{O_2}, pH receptors in the carotid body and aortic arch

ASC box

O_2 Transport

O_2 is primarily transported by hemoglobin; only a small portion is transported by solution.

ASC box

Physiology of Dyspnea

Multiple mechanisms lead to the sensation of dyspnea:

- Mechanical receptors in chest wall that feed back to respiratory motor neurons
- Lung stretch receptors
- Irritant receptors in bronchial mucosa activated by stimulation of bronchial mucosa and ↑ muscle tone and flow
- Central and peripheral chemoreceptors (even in the absence of activation of resp muscles)

CAUSAL CONDITIONS (Table 21.2)

TABLE 21.2 • Anatomic differential Dx of dyspnea

System	Mechanism	Differential Dx
Cardiac	Myocardial dysfunction	• Ischemic or hypertensive cardiomyopathy • Dilated cardiomyopathy • Infiltrative • Restrictive • Congenital • Diastolic dysfunction
	Arrhythmia	• Atrial fibrillation
	Pericardial dz	• Tamponade • Constrictive pericarditis
	↑ Cardiac output	• Pregnancy • Hyperthyroid
	Valvular heart dz	• Mitral regurgitation • Aortic stenosis
	Deconditioning	
Pulmonary	Airways	• Asthma • Anaphylaxis • COPD
	Parenchyma	• Alveoli (infectious, respiratory distress syndrome, vasculitis) • Diffusing membrane (interstitial pulmonary dz—sarcoid, scleroderma, fibrosis, inhalational, radiation, or drug-related) • Pneumonia • Aspiration
	Vasculature	• Pulmonary thromboembolic dz • Pulmonary arterial hypertension
	Pleura	• Pleural effusion • Pneumothorax, hemothorax
	Neuromuscular	• Guillain-Barré, myasthenia gravis • Spinal cord injury • ASA toxicity • Metabolic acidosis • Hypokalemia
	Chest wall	• Kyphoscoliosis • Obesity • Ankylosing spondylitis
Other		• Anemia • Anxiety • Carbon monoxide

APPROACH (Tables 21.3, 21.4, and 21.5)

- Differentiate cardiac versus pulmonary versus other causes of dyspnea
- See Acute and Chronic Dyspnea sections for specific etiologies

TABLE 21.3 • History clues to differentiate dyspnea

Breathing Description	Associated Condition
Heavy breathing	Deconditioning
Chest tightness	Obstructive (asthma), MI
↑ Effort of breathing	COPD, asthma, myopathy
Air hunger, need to breathe	CHF, PE, moderate to severe asthma
Suffocating	Pulmonary edema
Paroxysmal nocturnal dyspnea	CHF, asthma
Rapid, shallow breaths	Interstitial dz

TABLE 21.4 • Clinical findings of dyspnea

Resp Exam		
Auscultation	Stridor	Aspiration, anaphylaxis
	Crackles	Pulmonary edema/pneumonia
	Wheeze	Asthma, COPD
	Bronchial breath sounds	Consolidation
	Whispered pectoriloquy, egophony	Consolidation
Percussion	Dullness	Pneumonia, pleural effusion
	Hyperresonant	Pneumothorax, COPD
Palpation	Fremitus	↑ Consolidation ↓ bronchial obstruction, COPD, pneumothorax, and effusion
Cardiovascular Exam		
↑ JVP	CHF, PE	
Extra heart sounds (S_3, S_4, murmurs)	CHF, valvular heart dz, pulmonary hypertension	
Displaced PMI		
Tachypnea	PE, CHF	
Pulsus paradoxus	Tamponade, COPD, asthma	
Others		
Homan sign	Pain with foot dorsiflexion (DVT)	
Clubbing	ILD, lung cancer, cyanotic heart dz	

TABLE 21.5 • Systematic approach to CXR to avoid subtle abnormalities

View	Demographics (age, sex, history) Identify projection (PA, AP, Lat, portable, insp/exp, Lat decubitus) Heart magnified more on AP Patient position (upright vs. supine)
Technique	Insp effort (6 ribs anteriorly, 10 ribs posteriorly) Rotation (compare heads of clavicles) Penetration (should see the vertebral bodies through the cardiac silhouette)
Survey	Soft tissues Bony tissues Heart and vasculature Lung fields and pleura Beneath diaphragms Retrocardiac area

Clinical box

Important History Points

- Smoking history
- Medical history (heart dz, pulmonary dz)
- Exposures (sick contacts, immunocompromised, occupational, infections, irritants, allergies)
- Time course of Sx (acute vs. chronic)
- Exacerbating and alleviating factors

Clinical box

Brain Natriuretic Peptide

- Used to help differentiate heart failure from pulmonary dyspnea
- BNP is released by myocytes being stretched. BNP is cleaved to pro-BNP then to the biologically active form and the inactive amino terminal fragment NT-pro-BNP.
- Use of BNP or NT-pro-BNP in guiding CHF therapy is associated with a significant reduction of mortality and heart failure–related hospitalizations.
- BNP < 100 pg/mL or NT-pro-BNP < 400 pg/mL: CHF unlikely
- BNP > 400 pg/mL or NT-pro-BNP > 2,000 pg/mL: CHF likely

Clinical box

Hematocrit

Check Hct to exclude anemia as cause for dyspnea

ACUTE DYSPNEA

MCC OBJECTIVE

Based on Objective #27 (Dyspnea) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- A limited number of conditions cause shortness of breath that occurs over minutes to hours.
- Accurate, timely Dx is important as it permits swift treatment that can limit morbidity and mortality.

CAUSAL CONDITIONS

See Dyspnea section

APPROACH

Simplified Approach to ABGs

- pH acidemic or alkalemic?
- Resp or metabolic? In resp cause, Pco_2 and pH change in opposite directions.
- Appropriate compensation? (Table 21.6)

TABLE 21.6 • Compensation in Resp acid–base imbalance[a]

	Hco_3^- (mmol/L)	Pco_2 (mm Hg)
Acute resp acidosis	↑ By 10	↑ By 1
Chronic resp acidosis	↑ By 10	↑ By 3
Acute resp alkalosis	↓ By 10	↓ By 2
Chronic resp alkalosis	↓ By 10	↓ By 4

[a] If under- or over-compensated, consider mixed etiology.

- If metabolic acidosis, what is anion gap $[\text{Na}^+] - ([\text{Cl}^-] + [\text{Hco}_3^-])$? Normal is 14 ± 2.
- What is the delta gap—change in anion gap minus change in Hco_3?

If a positive gap exists ($> +6$), suggests another metabolic process such as metabolic alkalosis. If negative gap exists (< -6), then nonanion gap acidosis exists.

CAUSAL CONDITIONS (Table 21.7)

TABLE 21.7 • Causes of resp acid–base imbalance

Causes of Resp Acidosis	Resp Alkalosis
• CNS depression • Neuromuscular disorders • Upper and lower airway abnormalities • Lung parenchyma abnormalities • Thoracic cage abnormalities	• Hypoxia: pneumonia, pulmonary edema, restrictive lung dz • Primary hyperventilation: CNS disorders, drugs (salicylates), sepsis, hepatic failure

Status Asthmaticus

- Markers of severity—inability to speak full sentence, use of accessory muscles, pulsus paradoxus, inability to lie flat, normal to elevated CO_2
- ABG for severe cases
- Supportive therapy—O_2

Pulmonary Embolism

See Unilateral Edema section

CLINICAL BOX

Normal ABGs at Sea Level

pH: 7.4 (7.36–7.44)
Pco_2: 40 (37–42) mm Hg
Hco_3^-: 24 (22–26) mmol/L
Po_2: 80–100 mm Hg

CLINICAL BOX

Helpful Tests

- D-dimer—if negative, less likely to be PE
- BNP—positive in CHF
- ABG
- CBC
- CXR
- CT—PE
- V/Q scan
- ECG
- Echocardiography
- PFTs/spirometry
- C-ANCA suggests granulomatosis with polyangiitis (Wegener's).
- P-ANCA
- Troponin

CLINICAL BOX

Aspiration

- Need insp and exp x-ray views to look for evidence of gas trapping suggestive of foreign body
- Supportive therapy
- May require intervention (i.e., foreign body removal)

Acute Exacerbation of COPD

- Defined as sustained worsening of dyspnea, cough, or sputum production leading to ↑ use of maintenance medications
- Treat with oral or IV steroids 5 days
- Abx if ↑ sputum, purulence, or volume
- If uncomplicated, likely pathogens are *H. flu*, *M. catarrhalis*, and *S. pneumoniae.*
- First-line abx are **amoxicillin**, **doxycycline**, **septra,** or second or third generation cephalosporins.
- Second-line b-lactam, resp fluoroquinolone

Complicated COPD

- $FEV_1 < 50\%$ predicted
- > 4 exacerbations/yr
- Ischemic heart dz
- Home O_2
- Chronic oral steroids
- Abx within 3 mo
- First choice b-lactam/b-lactamase, fluoroquinolone
- May require consultation with a respirologist

Pneumonia

- Determine abx treatment based on most likely pathogen
- Assess for immunosuppression (i.e., HIV, solid organ transplant, chronic steroids, immunosuppressive drugs)
- CAP: if no comorbidities, likely organisms *S. pneumoniae*, *H. flu*, and atypicals including *C. pneumoniae*, *M. pneumoniae*, and *L. pneumophila*
- In uncomplicated outpatients (i.e., those without chronic pulmonary dz), first-line treatment is extended-spectrum macrolide or *doxycycline.*
- In complicated outpatients (i.e., those with COPD and recent abx use), treat with resp fluoroquinolone such as *levofloxacin* (Second line is *amoxicillin-clavulanate* or second-generation cephalosporin and macrolide.)
- Hospitalization based on pneumonia severity index score
- Hospital-acquired pneumonia (> 48 h) is more likely to be caused by resistant organisms or gram-negative bacteria—need broad-spectrum abx.

ArDS

- Manifestation of various acute lung injuries
- Four criteria are as follows:
    - Acute onset (within 1 wk of clinical insult)
    - Bilateral patchy airspace dz
    - PCWP < 18 mm Hg, or no clinical evidence of ↑ LVEDP
    - $Po_2/Fio_2 < 300$ mm Hg (≤ 300 is mild, > 100 but ≤ 200 is moderate, ≤ 100 is severe)
- Characterized by bilateral pulmonary infiltrates, resp distress, and hypoxemia
- Etiologies include aspiration/toxic inhalations, sepsis, shock, trauma, DIC, pancreatitis, embolism, drugs, and head trauma.
- Treat underlying disorder, immediate intensive care, aggressive supportive therapy

ASA Toxicity

- Suspect if combination of metabolic acidosis and concurrent resp alkalosis
- Mild toxicity characterized by nausea and vomiting, abdominal pain, and tinnitus
- More serious toxicity results in hyperthermia, tachypnea, resp alkalosis and metabolic acidosis, hypoglycemia, hypokalemia, seizure, coma, and death.
- Cardiopulmonary arrest due to pulmonary edema is the most common cause of death in ASA overdose.
- Decontamination of gut with charcoal
- Alkalinize the urine, dialysis indicated for severe toxicity

Vasculitis

- Granulomatosis with polyangiitis (Wegener's) and microscopic polyangiitis are characterized by pauci-immune necrotizing and crescentic glomerulonephritis and pulmonary capillaritis.
- Need specialist referral and hospitalization for high-dose steroids and pulsed cyclophosphamide to induce remission, followed by slow taper

CHRONIC DYSPNEA

MCC OBJECTIVE

Based on Objective #27 (Dyspnea) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Dyspnea lasting longer than 1 mo
- May be more difficult to determine etiology than with acute dyspnea
- In approximately two-thirds presenting with dyspnea cause is cardiopulmonary in origin.

CAUSAL CONDITIONS (Table 21.8)

TABLE 21.8 • Causes of dyspnea

COPD	22%
Asthma	20%
Congestive heart failure/coronary artery dz/CIRCU	16%
Obesity	16%
Psychogenic	10%
Interstitial lung dz	8%

Also see Table 21.2

COPD

- Affects 4% of Canadian adults
- Fourth leading cause of death worldwide
- Caused by smoking, biomass exposure (wood burning stoves)
- In nonsmokers, or patients with early presentation, consider α_1-antitrypsin deficiency
- Progressive, partially reversible airway obstruction with systemic effects and characterized by ↑ exacerbations
- Diagnose early through spirometry (FEV1/FVC < 0.70) on patients who:
  - Are smokers or ex-smokers > 40 y.o.
  - Have a exposure to risk factors such as chronic cough and/or sputum
  - Have frequent resp infections
  - Have progressive shortness of breath and exertion

APPROACH (Figure 21.1)

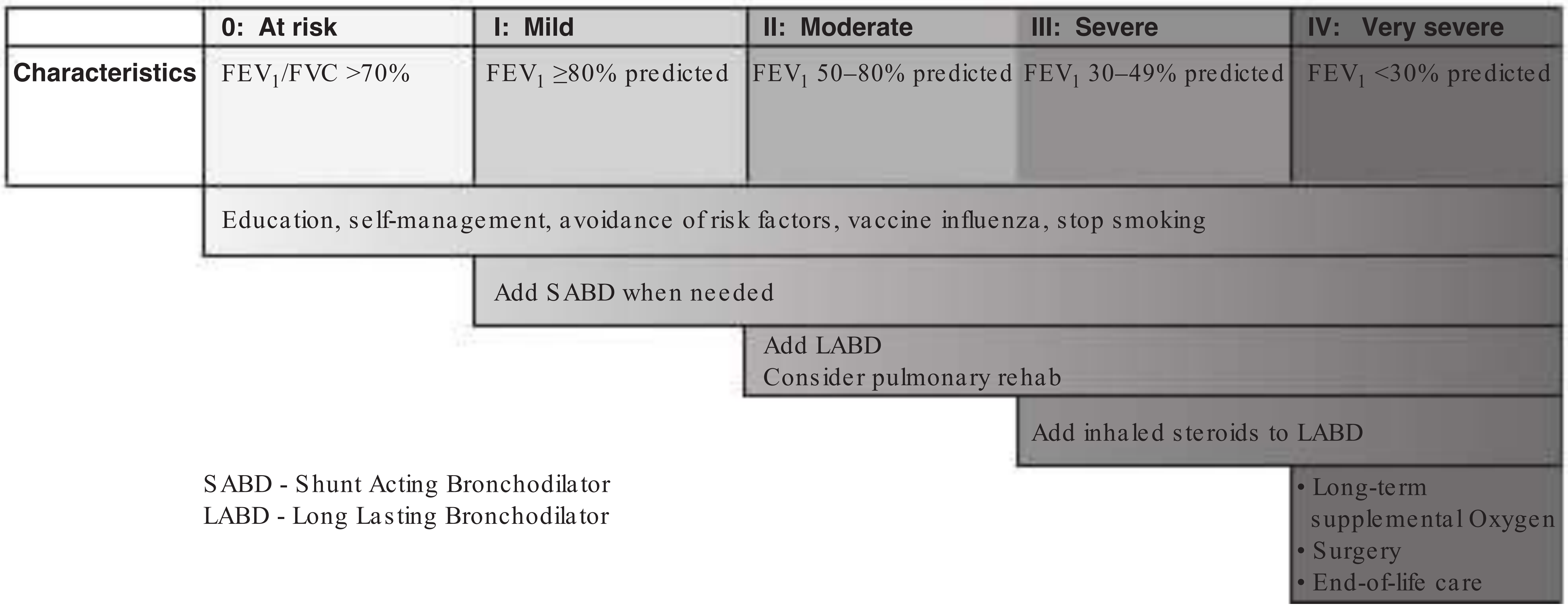


Figure 21.1. Steps in management of COPD.

clinical box

Tests to Evaluate Patients with Chronic Dyspnea

- Tier 1
  - History and exam (CBC, TSH, BNP)
  - PFTs (spirometry, lung volume, DLCO)
  - CXR

If no Dx,

- Tier 2
  - Cardiopulmonary exercise test
  - Echocardiogram
- Tier 3
  - CT chest
  - V/Q scan
  - Bronchoscopy
  - Thoracentesis
  - Nuclear stress test
  - Cardiac catheterization

clinical box

Indications for Cardiopulmonary Exercise Testing

- Used to evaluate and differentiate cardiac and pulmonary pathology
- Cardiac exercise test including measurements of resp O_2 uptake, CO_2 production, and ventilation (respiration rate, tidal volume, and minute ventilation)
- Considered medically necessary in evaluation of CHF patients being considered for heart transplant, differentiation of cardiac and pulmonary causes of ↓ exercise tolerance, or exercise-induced dyspnea

CLINICAL BOX

Goals in Management of COPD

- Relieve Sx
- Prevent dz progression
- Improve exercise tolerance
- Improve health status
- Prevent and treat complications
- Prevent and treat exacerbations
- Reduce mortality

CLINICAL BOX

Criteria for Home O_2 Therapy

- Evaluate for hypoxemia if FEV_1 < 40%
- Use long term O2 therapy (. 15 hr/day) if PO2 , 55, or , 60 mmHg with cor pulmonale.

CLINICAL BOX

Drug Therapy for Smoking Cessation

- Nicotine replacement
- Bupropion
- Varenicline

Smoking Cessation

Stages of change:

- Precontemplation: not interested in quitting; explore disadvantages of smoking and give personalized counseling
- Contemplative: plan on quitting in the next 6 mo
- Preparation: quit date < 1 mo; prescribe pharmacologic agents, create a plan of action, and review high-risk situations
- Action: within 6 mo of quitting; encourage and review plan of action
- Maintenance

ILD

Heterogeneous group of disorders predominantly affecting lung parenchyma

CAUSAL CONDITIONS (Table 21.9)

X-ray approach of ILD (Table 21.10) takes into consideration:

TABLE 21.9 • Classification of ILDs

Known causes	• Connective tissue dz–associated ILDs (e.g., Rheumatoid arthritis, polymyositis, scleroderma) • Hypersensitivity pneumonitis (e.g., farmer's lung, "hot tub" lung, "bird fancier's" lung) • Pneumoconioses (e.g., asbestosis, silicosis, coal worker's pneumoconiosis) • Drug-induced ILDs (e.g., chemotherapeutic agents, amiodarone, nitrofurantoin) • Smoking-related ILDs (pulmonary Langerhans cell histiocytosis, resp bronchiolitis-associated ILD, desquamative interstitial pneumonia, acute eosinophilic pneumonia) • Radiation-induced ILDs • Toxic inhalation-induced ILDs (e.g., cocaine, zinc chloride [smoke bomb], ammonia)

Unknown causes	• Idiopathic pulmonary fibrosis
	• Sarcoidosis
	• Other idiopathic interstitial pneumonias
	  ◦ Cryptogenic organizing pneumonia
	  ◦ Nonspecific interstitial pneumonia
	  ◦ Lymphocytic interstitial pneumonia
	  ◦ Acute interstitial pneumonia
	• Eosinophilic pneumonias
	• Pulmonary vasculitides
	• Pulmonary lymphangioleiomyomatosis
	• Pulmonary alveolar proteinosis
	• Many other rare disorders

TABLE 21.10 • X-ray patterns of ILD

Peripheral Bibasilar Reticular Patterns	Nodular Pattern
• IPF (UIP)	• Fungal dz
• Asbestosis	• Metastatic dz/lymphangitic carcinomatosis
• Pulmonary fibrosis associated with connective tissue dz	• Silicosis
	• Sarcoidosis
• Chronic hypersensitivity	• Histiocytosis X

- Distribution of dz
- Nodular versus reticular
- Lymph node involvement
- Presence of pleural effusions

Dx of IPF suggested by:

- Progressive exertional dyspnea in middle- to older-age patients with bibasilar inspiratory crackles
- Restrictive pattern on PFT testing and impaired gas exchange
- Bilateral peripheral reticular opacities and subpleural honeycombing with basal predominance on high resolution CT scan
- Exclusion of other causes (i.e., drug toxicities, exposures)

Requires referral to a respirologist for definitive Dx

Bronchiectasis

- Permanent dilation of the airways due to repeat cycles of infection and inflammation
- Suspect in patients with chronic cough and purulent sputum and/or hemoptysis
- Causes severe pulmonary infections, loss of lung function, morbidity, and premature mortality
- Diagnosed with high resolution CT scan; obstruction seen on PFT
- Etiology (Table 21.11)

CLINICAL box

Approach to Patients with Bronchiectasis

- Evaluate for underlying causes
- Assess sputum for organisms
- Consider pharmacologic + nonpharmacologic treatments to ↓ bacterial burden/minimize exacerbations
- Lung transplant as last resort

CLINICAL box

Management Strategies for Bronchiectasis

Goal: to reduce number of exacerbations and improve quality of life

- Tailor abx therapy to pathogens identified in sputum analysis
- Anti-inflammatory therapy
    - Consider inhaled steroids or macrolide therapy
- Mobilize secretions with chest physio postural drainage, active cycle of breathing, pulmonary rehabilitation
- Surgery for focal dz

TABLE 21.11 • Etiology of bronchiectasis

Etiology	%
Postinfectious	29–35
Idiopathic	26–53
Genetic dz (CF, PCD, and AAT deficiency)	4–11
Aspiration/GERD	1–4
Immune deficiency	7–8
Rheumatoid arthritis	2–3
Ulcerative colitis	1–3
ABPA	7–8

CF: cystic fibrosis; PCD: primary ciliary dyskinesia; AAT: alpha-1 antitrypsin; ABPA: allergic bronchopulmonary aspergillosis

UPPER RESPIRATORY TRACT DISORDERS: WHEEZE

MCC OBJECTIVE

Based on Objective #27 (Dyspnea) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Wheezing is a sign of obstructing airway and indicates a pathologic process. Requires sufficient airflow to produce sound. Absence of wheeze in acute asthma can be ominous sign.
- Stridor is a high-pitched sound caused by oscillation of narrowed airway, signifying significant obstruction of large airways, and always should prompt urgent airway evaluation.

C$_2$ L E O

Physicians' legal liability for negligence

A physician may fail to recognize that wheezing does not equate to asthma. In an acute situation, life-threatening illnesses should be considered (epiglottitis, mechanical airway obstruction).

APPROACH

History

- Associated Sx of cough, dyspnea, ± chest tightness ↑ probability of asthma
- Presence of postnasal drip or reflux Sx is most common contribution to uncontrolled asthma.
- History of cardiac dz or signs of CHF
- History of cancer or Sx suggestive of malignancy

Interpreting PFTs (Table 21.12):

TABLE 21.12 • Patterns of dz in pulmonary function testing

	FVC	FEV_1/FVC	TLC	RV	DLCO
Obstructive	Can be normal or reduced	Reduced < 70%	Increased or normal (increased suggests hyperinflation)	Increased or normal (increased suggests gas trapping)	Normal or reduced in moderate to severe emphysema
Restrictive (lung)	Reduced	Normal	Reduced < 80%	Reduced	Reduced
Restrictive (chest wall)	Reduced	Normal	Reduced < 80%	Reduced	Normal
Pulmonary vascular dz	Normal	Normal	Normal	Normal	Normal

- PFTs routinely look at four main variables:
  - Flow volume curve can give clues about presence and location of obstruction (upper airways vs. lower airways) or presence of restriction (Figure 21.2 and Table 21.13).

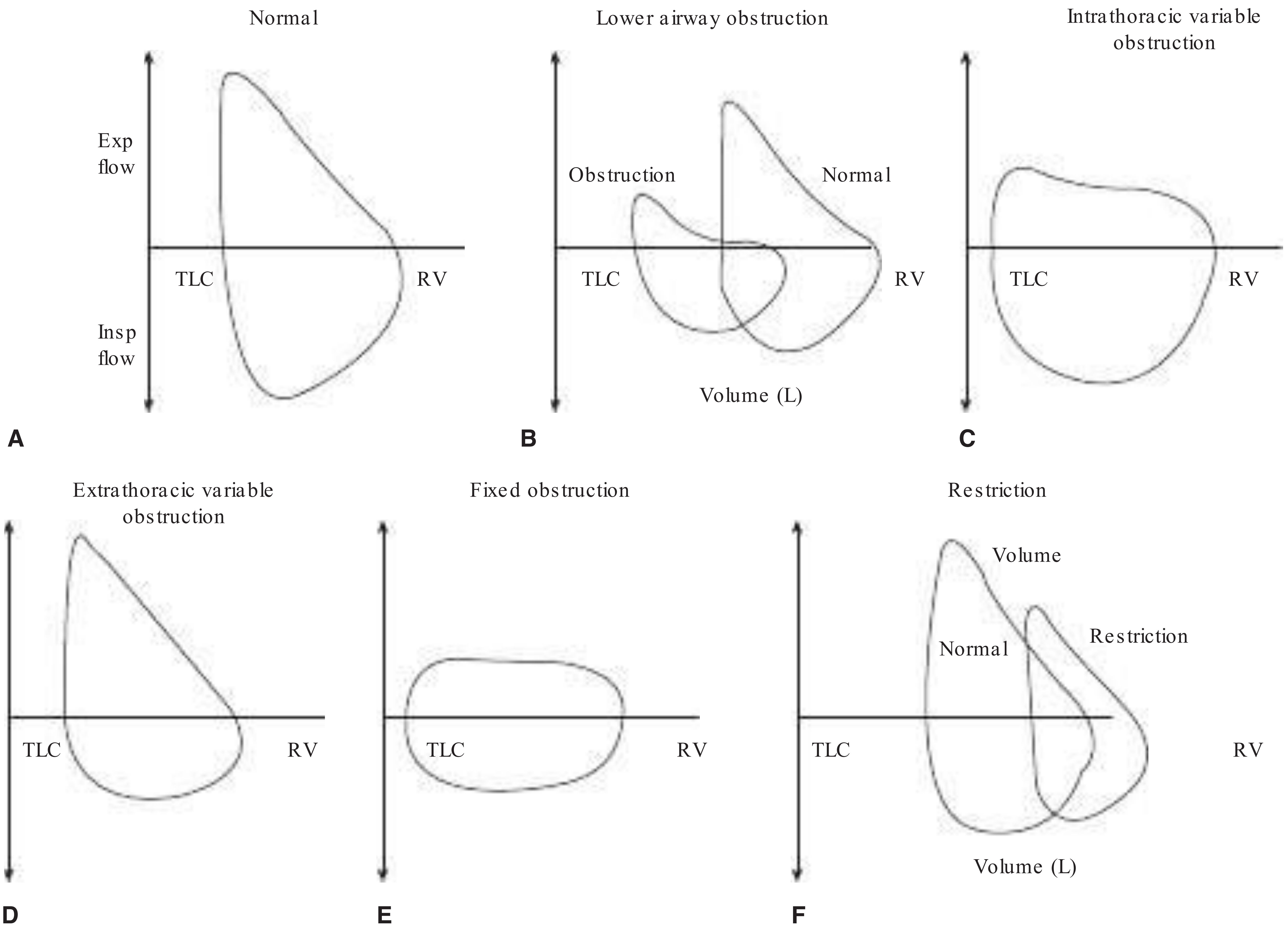


Figure 21.2. Lung volumes.

- Flow—FVC, FEV$_1$, FEV$_1$/FVC ratio (used in evaluating whether there is obstructive etiology)
- Volume—TLC, RV, FRC (used in evaluating restrictive lung dz)
- Diffusion—DLCO

For the differences between wheeze and stridor, see Table 21.14

TABLE 21.14 • Wheeze versus stridor

	Wheeze		Stridor
Character	• Monophonic—constant acoustical character—signifies large airway obstruction • Polyphonic—variable quality and acoustical character—signifies small airway obstruction • Inspiration or expiration • High-pitched or low-pitched • Airway of any size • Large: constant acoustic character • Small: variable acoustic character • If localized in one part of chest, consider neoplasm or foreign body		• Monophonic • Loudest over central airways • Inspiration, expiration, or throughout • Large airway—intrathoracic or extrathoracic • Insp stridor—extrathoracic obstruction • Exp stridor—intrathoracic obstruction
Causes	• Acute • Asthma • Infection • Bronchitis • Viral infection • Pneumonia • Foreign body • Aspiration • Esophageal • CHF	• Chronic • Asthma—postnasal drip • COPD • Gastroesophageal reflux • Recurrent aspiration • Pulmonary edema • Cystic fibrosis • VCD • ILD • Retained foreign body	• Vocal cord dysfunction (VCD)[a] • Retrosternal goiter/tumor compression • Angioedema • Foreign body[a] • Croup[a] (brassy cough, night Sx, previous upper resp tract infection • Epiglottitis[a] • Hypertrophied tonsils[a]

[a] Most common in children.

ASC box

Three potential anatomic areas for obstruction:

1. Extrathoracic upper airways (nose to extrathoracic trachea)
2. Intrathoracic upper airways (intrathoracic trachea)
3. Lower airways (intrathoracic airways below carina)

!

Always consider potential complete airway obstruction possible in stridor

Management

Stridor

- Emergent airway evaluation—direct laryngoscopy/bronchoscopy
- Prepare for establishing an emergency airway
- Patients must remain under direct observation.

Wheeze

- Patient unstable? (RR > 30, accessory muscles, becoming fatigued, CO$_2$ retention)
- Consider emergent airway with intubation
- Stable—use history to determine cause

Management of Acute Wheeze/Asthma

- O$_2$ (titrate to achieve Sao$_2$ > 90%)
- Short-acting b-agonist (4–8 puffs q20min or nebulizer 2.5–5 mg q20min, continuous if severe)
- Prednisone 60 mg PO for suspected asthma exacerbation or IV methylprednisolone
- Ipratropium (MDI 4–8 puffs q30min or nebulizer 0.5 mg q30min × 3, combined with b-agonist)
- Magnesium 2 g IV over 20 min (in very severe asthma exacerbations)
- In ICU setting: epinephrine or inhaled anesthetic gases

CLINICAL box

Initial Investigations

- CBC to assess WBC
- ABG to assess for hyperpnea and hypoxemia
- CXR to assess for consolidation, pleural effusion, pneumothorax, heart failure
- EKG to exclude ACS

CYANOSIS / HYPOXEMIA / HYPOXIA

MCC OBJECTIVE

Based on Objective #19 (Cyanosis, Hypoxia) of *Objectives for the Qualifying Examination*, 3rd edition.

- See also Chapter 18

OVERVIEW (Table 21.15)

TABLE 21.15 • Definitions

Cyanosis	• Physical sign of bluish coloration of the skin due to the presence of > 50 g/L of deoxygenated hemoglobin in blood vessels near the skin surface • O_2 saturation of arterial blood falls below 85%.
Hypoxemia	• An abnormal deficiency in the concentration of O_2 in arterial blood • Can be reversed with supplemental O_2
Hypoxia	• Total body is deprived of O_2.

CAUSAL CONDITIONS (Figure 21.3)

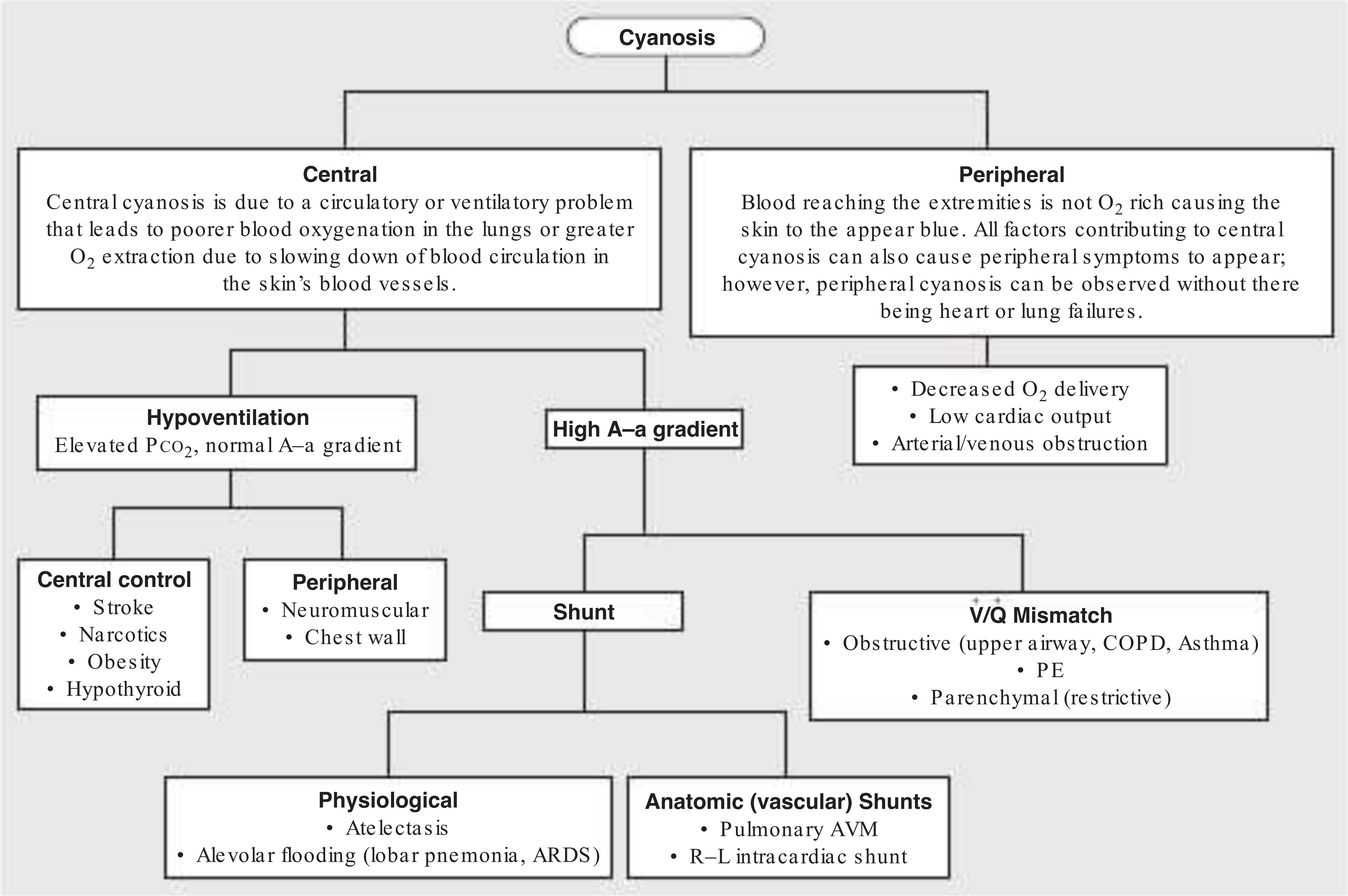

Cyanosis
Central
Central cyanosis is due to a circulatory or ventilatory problem that leads to poorer blood oxygenation in the lungs or greater O_2 extraction due to slowing down of blood circulation in the skin's blood vessels.
Peripheral
Blood reaching the extremities is not O_2 rich causing the skin to the appear blue. All factors contributing to central cyanosis can also cause peripheral symptoms to appear; however, peripheral cyanosis can be observed without there being heart or lung failures.
• Decreased O_2 delivery
• Low cardiac output
• Arterial/venous obstruction
Hypoventilation
Elevated P_{CO_2}, normal A–a gradient
High A–a gradient
Central control
• Stroke
• Narcotics
• Obesity
• Hypothyroid
Peripheral
• Neuromuscular
• Chest wall
Shunt
$\dot{V}/\dot{Q}$ Mismatch
• Obstructive (upper airway, COPD, Asthma)
• PE
• Parenchymal (restrictive)
Physiological
• Atelectasis
• Alevolar flooding (lobar pnemonia, ARDS)
Anatomic (vascular) Shunts
• Pulmonary AVM
• R–L intracardiac shunt

Figure 21.3. Classification of cyanosis.

APPROACH (Figure 21.4)

- Patients will show signs of dyspnea, confusion, altered consciousness, cardiac arrhythmias, cyanosis, diaphoresis, and tachypnea.

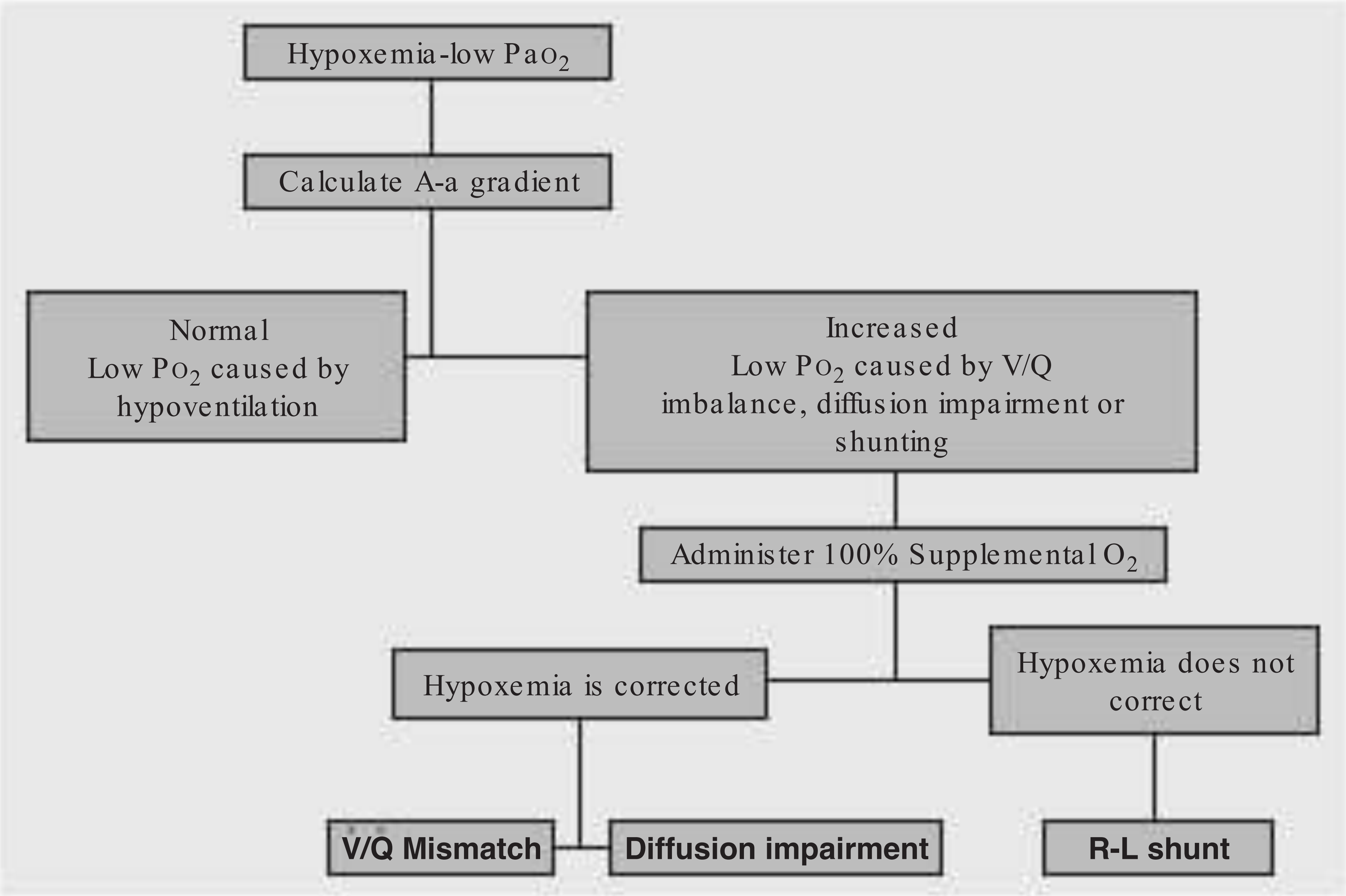

Hypoxemia-low Pao_2
Calculate A-a gradient
Normal
Low Po_2 caused by hypoventilation
Increased
Low Po_2 caused by V/Q imbalance, diffusion impairment or shunting
Administer 100% Supplemental O_2
Hypoxemia is corrected
Hypoxemia does not correct
V/Q Mismatch
Diffusion impairment
R-L shunt

Figure 21.4. Approach to resp failure.

- Dx requires ABGs and CXR.
- Patients who have these signs should be treated with supplemental O_2.

COUGH

MCC OBJECTIVE

Based on Objective #18 (Cough) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Chronic cough is a common problem causing patients to require medical attention.
- Most common causes are postnasal drip, asthma, gastroesophageal reflux, and drugs.

CAUSAL CONDITIONS (Table 21.16)

TABLE 21.16 • Causal conditions of cough by etiology

Chronic	Acute
Upper Resp • Postnasal drip • Gastroesophageal reflux • Chronic sinusitis • Drugs (ACE inhibitors) • Foreign body (more common in children)	Infectious • URTI • Bronchitis • Pneumonia
Pulmonary • Obstructive airway dz (asthma, chronic bronchitis, bronchiectasis, cystic fibrosis)	Irritant • Noxious fumes • Smoke

(continued)

CLINICAL BOX

Risks of Long-term O_2 use

CO_2 retention in patients with COPD and O_2 toxicity can occur with high concentration of O_2.

CLINICAL BOX

Alveolar–Arterial Gradient (A–a Gradient)

Used to compare the causes of hypoxemia

- Normal < 10 mm Hg, but can range from 5 to 20 mm Hg in a normal individual
- An ↑ in A–a gradient suggests a diffusion defect, V/Q (ventilation/perfusion) defect, or right-to-left shunt.
  A–a gradient = $\text{Pao}_2 - \text{Pao}_2$
  Pao_2 = Alveolar Po_2 (calculated from the alveolar gas equation)
  $\text{Pao}_2 = (P_{bar} - P_{h_2o}) \times \text{Fio}_2 - \text{Paco}_2/R$
  $\text{Pao}_2 = (760 - 47) \times \text{Fio}_2 - \text{Paco}_2/0.8$ at sea level
  Pao_2 = Arterial Po_2 (from ABGs)

Note: P_{h_2o} is always 47 mm Hg, assuming the patient's body temperature is approximately 37°C; P_{bar}, however, changes with elevation.

TABLE 21.16 • (continued)

Chronic	Acute
- Lung neoplasm - Chronic lung infections (lung abscess, TB, aspiration) - ILD	- Foreign body
Cardiac - CHF	

APPROACH (Figure 21.5)

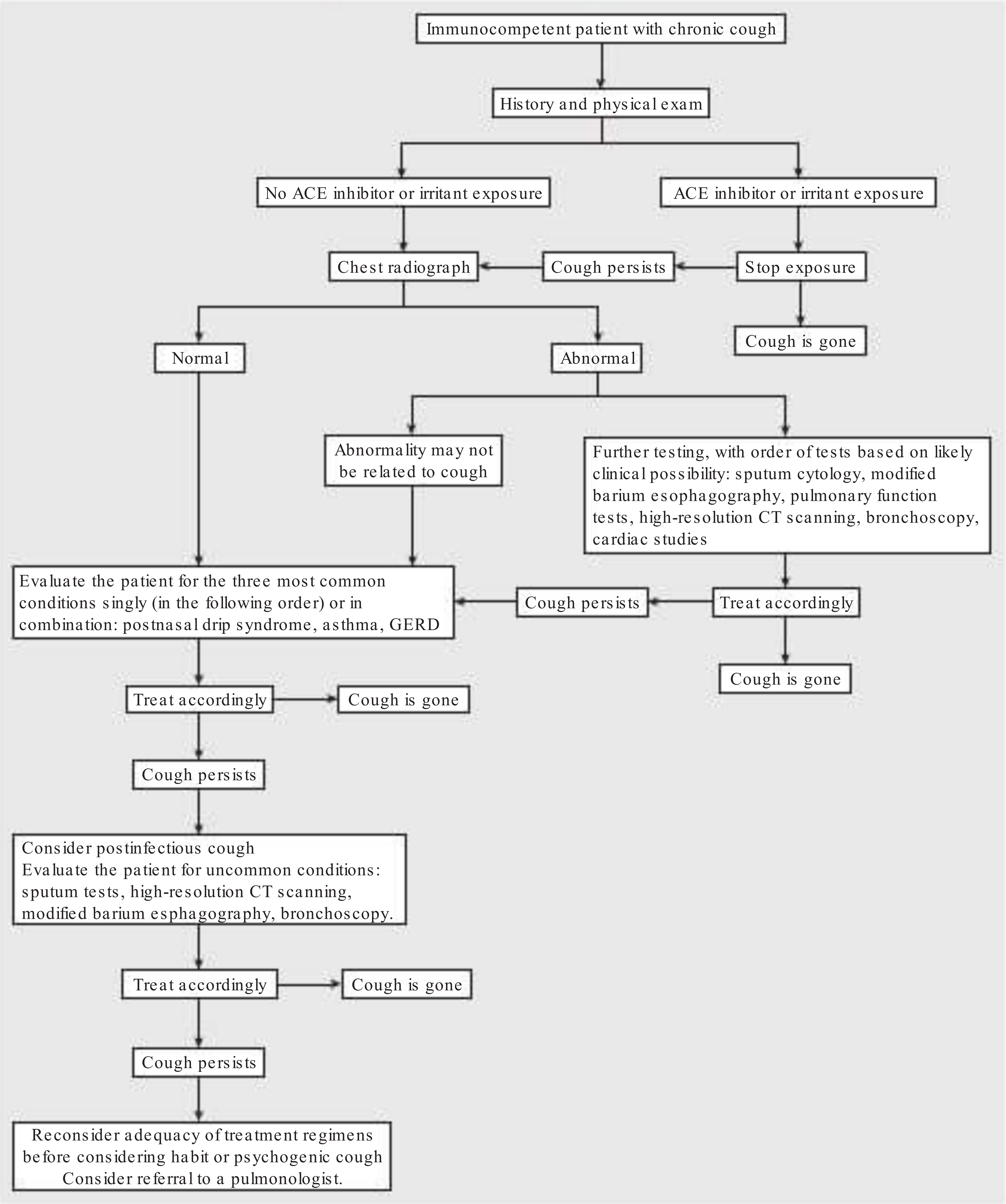

Immunocompetent patient with chronic cough
History and physical exam
No ACE inhibitor or irritant exposure
ACE inhibitor or irritant exposure
Chest radiograph
Cough persists
Stop exposure
Cough is gone
Normal
Abnormal
Abnormality may not be related to cough
Further testing, with order of tests based on likely clinical possibility: sputum cytology, modified barium esophagography, pulmonary function tests, high-resolution CT scanning, bronchoscopy, cardiac studies
Evaluate the patient for the three most common conditions singly (in the following order) or in combination: postnasal drip syndrome, asthma, GERD
Cough persists
Treat accordingly
Cough is gone
Treat accordingly
Cough is gone
Cough persists
Consider postinfectious cough
Evaluate the patient for uncommon conditions: sputum tests, high-resolution CT scanning, modified barium esphagography, bronchoscopy.
Treat accordingly
Cough is gone
Cough persists
Reconsider adequacy of treatment regimens before considering habit or psychogenic cough
Consider referral to a pulmonologist.

Figure 21.5. Evaluation of patients with chronic cough.

CXR

Smoker

- Abnormal CXR may suggest bronchiectasis and bronchogenic carcinoma, and a CT scan should be performed for these Dx.
- Patients with a normal CXR with recurring Sx of chronic cough should consult a pulmonologist for PFT.

Nonsmoker

- Normal CXR of a nonsmoker often rules out the likelihood of pneumonia, infiltrative dz, or bronchiectasis.
- Consider postnasal drip syndrome with upper resp tract and sinus Sx as a possible cause
- Management of postnasal drip syndrome by combination of decongestants and antihistamine
- If treatment is successful, patients should continue for 2 wk and then discontinue with Sx subside; if Sx continue, asthma should then be considered as a potential cause.
- Cough may be the sole manifestation of asthma; for Dx and management, see "Lower Respiratory Tract Disorders" section.
- Heartburn, hoarseness of voice, or early morning cough could suggest GERD; 24-h esophageal pH monitoring may be conducted, or medical management with proton-pump inhibitors should be considered.
- Other causes may include pneumonia or bronchitis when chronic cough is followed with purulent sputum.

- Cough receptors (mechanical and chemical) from:
  - Resp epithelium
  - Pericardium
  - Esophagus
  - Diaphragm
  - Stomach
- Stimulate through afferent nerves the medullary cough center that activates exp muscles through efferent nerves

BLOOD IN SPUTUM

MCC OBJECTIVE

Based on Objective #7 (Blood in Sputum [Hemoptysis]) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Expectoration of blood or blood-streaked sputum
- Massive hemoptysis occurs at expectoration > 100 to 600 mL of blood over a 24-h period, when there are identifiable features of hemodynamic instability, altered gas exchange, or resp difficulties.

CLINICAL BOX

In massive hemoptysis, "patients die of asphyxiation not exsanguination."

APPLIED SCIENTIFIC CONCEPTS

- Although the bronchial arteries only carry < 1% of the cardiac output to the lung, > 90% of the time hemoptysis originates from these arteries (due to much higher pressures as compared to the pulmonary arteries).
- The bronchial arteries supply nutritive blood supply for the airways, hilar lymph nodes, visceral pleura, and some of the mediastinum.

In massive hemoptysis (> 200 mL/d), ensure adequacy of ventilation and hemodynamic stability first and consult a specialist.

CAUSAL CONDITIONS (Table 21.17)

TABLE 21.17 • Causal conditions of hemoptysis

Airway dz	
Inflammatory	• Bronchitis (acute, chronic) • Bronchiectasis, lung abscess, cystic fibrosis
Neoplasms	• Bronchogenic carcinoma • Endobronchial metastatic carcinoma (melanoma, breast, renal, colon) • Bronchial carcinoid • Kaposi sarcoma (in patient with AIDS)
Other	• Foreign body • Trauma

(continued)

TABLE 21.17 • (continued)

Pulmonary Parenchymal dz	
Infectious	• TB, necrotizing pneumonia, mycetoma, aspergilloma
Inflammatory/immune	• Goodpasture, pulmonary hemosiderosis, Wegener's, lupus
Other	• Coagulopathy, iatrogenic, cocaine, endometriosis
Cardiovascular	
Elevated capillary pressure	• Mitral stenosis, tricuspid endocarditis, LV failure
Other	• Pulmonary embolus with infarction, AV malformation

CLINICAL box

Nosebleeds and Hoarseness of Voice

Suggest bleeding from upper resp tract

CLINICAL box

Coffee-Ground Emesis

Hematemesis is occasionally difficult to distinguish from hemoptysis as blood from a resp source may be swallowed and present as coffee-ground emesis.

APPROACH

History

- Anticoagulation use
- Sx of CHF
- Infectious Sx
- Immunosuppression
- HIV risk factors
- Travel history
- Chronic cough and sputum suggestive of bronchiectasis
- Sx to suggest PE
- Wt loss, fever, night swears suggestive of malignancy
- Smoking history
- GI and nasal Sx to suggest alternative source of blood

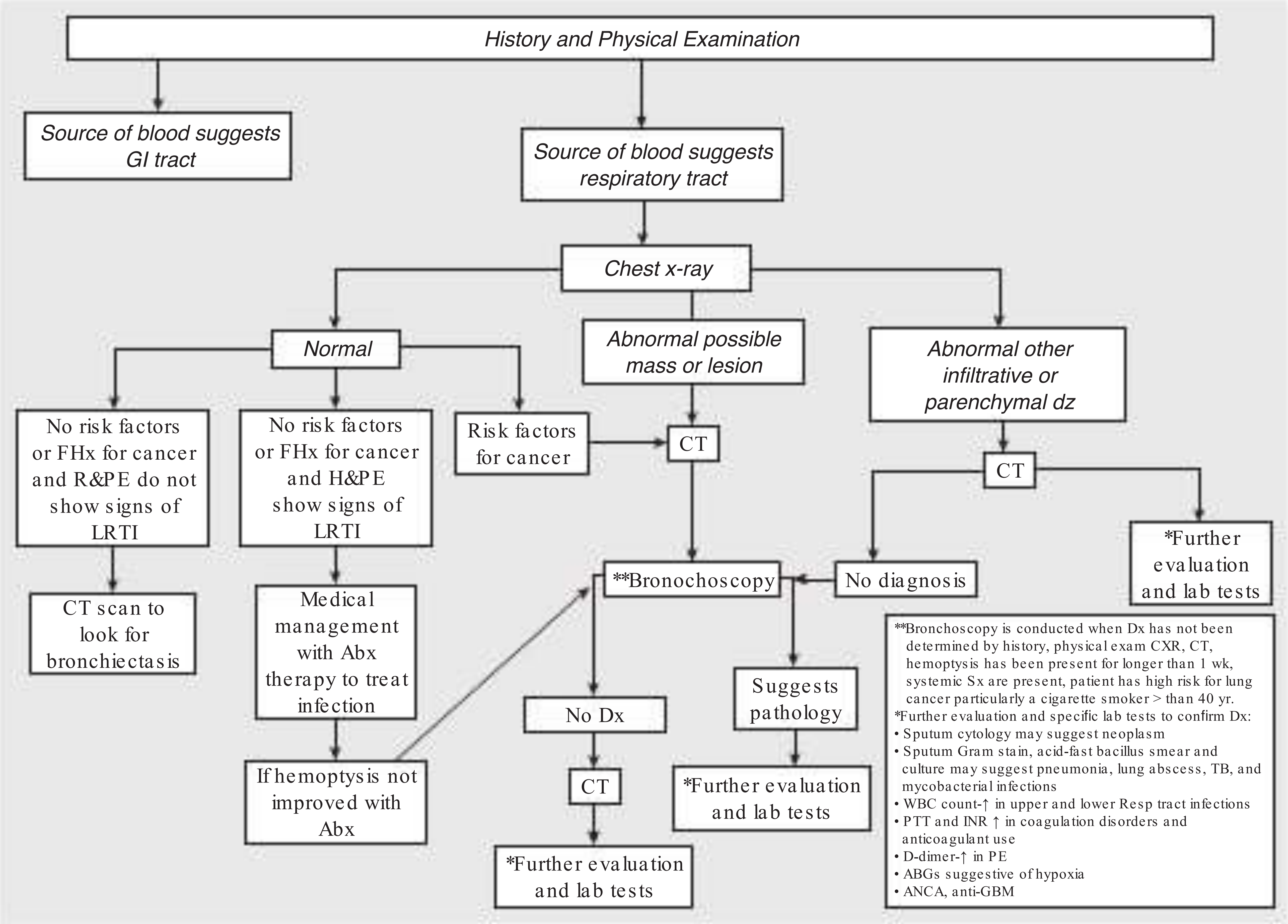
Physical Exam (Table 21.18)

TABLE 21.18 • Points on physical exam

Lung cancer	Cachexia, clubbing, Horner syndrome, SVC syndrome, unilateral vocal cord paralysis
Etiologies of Clubbing	Causes of clubbing include primary lung cancer, lung abscess, chronic lung disease (NOT typically simple COPD), lung metastases, bronchiectasis.
Wegener's	Nasal discharge, nasal septum perforation, saddle nose deformity, palpable purpura, polyarthralgias, joint tenderness, rash, mononeuropathy, active urine sediment, renal failure, hematuria
Infections	Fever, bronchial breath sounds, toxic changes
PE	pleural rub, right-sided heart failure, shock

General Approach (Figure 21.6)

- Determine if blood is coming from bronchial region, lungs, upper resp tract, nasopharynx, or GI tract
- If bleeding not from lungs, examine upper resp system
- Upper GI workup needed when the bleeding source is unclear


History and Physical Examination
Source of blood suggests GI tract
Source of blood suggests respiratory tract
Chest x-ray
Normal
Abnormal possible mass or lesion
Abnormal other infiltrative or parenchymal dz
No risk factors or FHx for cancer and R&PE do not show signs of LRTI
No risk factors or FHx for cancer and H&PE show signs of LRTI
Risk factors for cancer
CT
CT
*Further evaluation and lab tests
CT scan to look for bronchiectasis
Medical management with Abx therapy to treat infection
**Bronchoscopy
No diagnosis
No Dx
Suggests pathology
If hemoptysis not improved with Abx
CT
*Further evaluation and lab tests
*Further evaluation and lab tests

**Bronchoscopy is conducted when Dx has not been determined by history, physical exam CXR, CT, hemoptysis has been present for longer than 1 wk, systemic Sx are present, patient has high risk for lung cancer particularly a cigarette smoker > than 40 yr.

*Further evaluation and specific lab tests to confirm Dx:
- Sputum cytology may suggest neoplasm
- Sputum Gram stain, acid-fast bacillus smear and culture may suggest pneumonia, lung abscess, TB, and mycobacterial infections
- WBC count-↑ in upper and lower Resp tract infections
- PTT and INR ↑ in coagulation disorders and anticoagulant use
- D-dimer-↑ in PE
- ABGs suggestive of hypoxia
- ANCA, anti-GBM

Figure 21.6. Approach to Dx of blood in sputum.

Investigations (Table 21.19)

TABLE 21.19 • Diagnostic tests to confirm etiology of hemoptysis

Sputum Cytology	Neoplasm
Sputum Gram stain, acid-fast bacillus smear and culture	Pneumonia, lung abscess, TB, and mycobacterial infections
WBC	↑ In upper and lower RTI
PTT and INR	Coagulation disorders and anticoagulant use
d-dimer	PE
ABG	Hypoxia
ANCA, anti-GBM	Autoimmune

Management

Nonspecific Hemoptysis
- Evaluate ABCs and stop hemoptysis by treating underlying cause
- If normal CXR, monitor on outpatient basis
- If abnormal CXR, follow-up with CT and consider referral to specialist for bronchoscopy

Massive Hemoptysis
- Maintain ABCs
- Consult with pulmonologist
- Suggest specialized intensive care, consider supplemental O_2, and prepare for possible emergency surgery

LOWER RESPIRATORY TRACT DISORDERS

MCC OBJECTIVES

Based on Objectives #27 (Dyspnea) and #18 (Cough) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Sx include dyspnea, cough, possible sputum production.
- Includes multiple disorders, including bronchiectasis and cystic fibrosis (associated with recurrent infections; see Table 21.20)

TABLE 21.20 • Anatomic classification of LRT disorders

Mechanism	Differential Dx
Large airways (obstructive lung dz)	• COPD (emphysema and chronic bronchitis) • Asthma • Bronchiectasis • Cystic fibrosis
Small airways	• Aspiration • Bronchiolitis • Cystic fibrosis
Interstitium	• Interstitial lung dz
Vascular	• Pulmonary hypertension
Extra pulmonary	• Pulmonary edema

APPROACH

History (Table 21.21)

TABLE 21.21 • Common Sx to differentiate LRT disorder on history

Asthma	Nocturnal wheeze, cough, or dyspnea; chest tightness; waxing and waning Sx; nocturnal Sx, seasonal variation; Sx exacerbated by cold, exercise, dust
COPD	Dyspnea is hallmark Sx, particularly on exertion; chronic cough, sputum production, prior history of smoking, frequent resp infections
Bronchiectasis	Chronic resp infections, chronic cough, purulent sputum production, fever, weakness, Wt loss, hemoptysis, dyspnea (less frequently)
CHF	Orthopnea; nocturnal wheeze, cough, or dyspnea, leg swelling; dyspnea on exertion; fatigue
Interstitial lung	Progressive dyspnea on exertion then at rest, hypoxia (later stages), dry cough, occupational/drug exposure, autoimmune history
Aspiration	History of stroke/seizure, neuromuscular dz, ETOH, or drug abuse affecting level of consciousness, use of sedating medications, elderly, GERD
PE	Sudden dyspnea on exertion or rest, leg swelling, risk factors for DVT

Physical Exam (Table 21.22)

TABLE 21.22 • Findings on physical exam and CXR to differentiate LRT disorders

	Physical Exam	CXR Findings
Asthma	• Can be associated with nasal polyps • Often normal; may hear wheeze or quiet chest (in severe cases)	• Often normal
COPD	• Normal—mild dz • Prolonged expiration on forced exhalation (> 6 sec)—moderate–severe • ↓ Breath sounds in moderate to severe • ↑ AP diameter—moderate–severe • Paradoxical breathing—severe • Pulmonary HTN with right-sided failure (RV heave, loud S_2, fixed split S_2, JVP distension, leg swelling)—severe	• ↑ AP diameter • Hyperinflation (flat diaphragm/ increased retrosternal airspace) • Evidence of bullae
Bronchiectasis	• Nasal polyps and evidence of sinusitis may be present. • Crackles	• Sometimes normal • Dilated bronchi • Tram tracks (thin parallel lines coming from hilum)
CHF	• Bibasilar crackles • Elevated JVP, S_3/gallop,, displaced apex • Evidence of valvular dz • Leg swelling	• Vascular redistribution to apical area • Fluid in the fissures • Fluffy opacities (unilateral or bilateral) • Pleural effusions • Kerley B lines • Peribronchial cuffing
Interstitial lung	• Clubbing (IPF) • Fine crackles • Evidence of rheumatologic dz • Pulmonary HTN with right-sided failure (RV heave, loud S_2, fixed split S_2, JVP distention, leg swelling)	• Variable findings—nodules or reticulations
Aspiration	• Crackles (often right sided but can be bilateral), wheeze, fever	• Can range from minimal findings to pneumonia and/or ARDS
PE	• Fever, tachypnea, tachycardia • Hypotension, elevated JVP, pulsus in large PE	• Often normal; may have evidence of Hampton hump if infarction of lung • Westermark sign (oligemia after area of clot)

ASTHMA

MCC OBJECTIVES

Based on Objectives #27 (Dyspnea) and #18 (Cough) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Paroxysmal or persistent Sx include dyspnea, wheeze, chest tightness, cough, and sputum production.
- Variable airflow limitation
- Presence of hyperresponsive airways
- Associated with allergies, atopic dermatitis, seasonal allergic rhinitis, and conjunctivitis
- Dx by combination of compatible clinical history with spirometry, peak expiratory flow variability, methacholine challenge, or exercise challenge for an objective Dx (Table 21.23)

C_2 L E O

Physicians' legal liability for negligence

Failure to properly assess and ascertain the severity of a patient's asthma and to pursue the appropriately aggressive treatment for this potentially lethal illness in a timely manner Failure to properly assess and ascertain the severity of a patient's asthma and to pursue the appropriately aggressive treatment for this potentially lethal illness in a timely manner

CLINICAL box

Properly Controlled Asthma

- Daytime Sx < 4/wk
- Nighttime Sx < 1/wk
- Capable of normal physical activity, no work/school absence
- Mild/few exacerbations
- Rescue puffer < 4 dose/wk
- $FEV_1 \geq 90\%$ of patient's best
- PEF ≥ 90% of patient's best
- PEF diurnal variation < 10% to 15%
- Sputum eosinophils < 2% to 3%

TABLE 21.23 • Diagnostic testing for asthma

Spirometry	To diagnose asthma, reversible airway obstruction should be present, with FEV_1 being the gold standard for measuring reversibility. Bronchodilator response is measured by repeating spirometry 15–30 min after inhalation of bronchodilator; ≥ 12% and 200 mL ↑ in FEV_1 or FVC is positive response.
Peak expiratory flow (PEF) measurements	Can be done at home; > 8% variability on twice-daily readings, > 20% variability on multiple daily readings, > 6 L/min ↑ after bronchodilator or course of controller therapy
Methacholine challenge	Used if history suspicious for asthma but normal spirometry; positive test exists when a ↓ in FEV_1 of 20% or more occurs after low-dose inhaled methacholine
Exercise testing	≥ 10%–15% ↓ in FEV_1 postexercise
Allergy testing	Indicated when any concern re induction of Sx due to exposure to indoor allergens

Management

All patients:

- Education on trigger avoidance
- Action plan
- Proper use of inhalers (Table 21.24)

TABLE 21.24 • Treatment of asthma

Step	Treatment
1. Mild intermittent	• Sx ≤ 2× /wk, nocturnal Sx ≤ 2× /mo, normal lung function, normal activity • No long-term control, short-acting b-agonist for Sx relief
2. Mild persistent	• Sx > 2× /wk, nocturnal Sx > 2× /mo, activity may be affected, normal PF/FEV_1 but PF variability 20%–30%, short-acting b-agonists use > 2 d/wk • Low-dose inhaled corticosteroid plus short-acting b-agonist for Sx relief
3. Moderate persistent	• Daily Sx, daily use of b-agonist, activity affected, exacerbations > 2× / wk, nocturnal Sx > 1× /wk, FEV_1 60%–80% predicted or PF variability > 30% • Medium-dose inhaled corticosteroid or low- to medium-dose inhaled corticosteroid with long-acting b-agonist plus short-acting b-agonist for Sx relief
4. Severe persistent	• Continual Sx, limited physical activity, frequent exacerbations, nighttime Sx frequent, FEV_1 < 60% predicted, or PF variability > 30% • High-dose inhaled corticosteroid and long-acting bronchodilator ± anti-IgE treatment (omalizumab) ± leukotriene receptor antagonist ± oral corticosteroids

- Escalate therapy if control not achieved and patient is adherent until control is achieved

Reasons for poor asthma control:

- Poor adherence
- Lack of education about asthma and medication
- Not using objective measures to assess control (peak flow or FEV_1)

APPLIED SCIENTIFIC CONCEPTS (Table 21.25)

TABLE 21.25 • Cellular mechanisms of asthma and treatment

	Role	Pharmacologic Interventions
Mast cells	• Early phase allergen response by cross-linked IgE activation • Release of histamine, tryptase, leukotriene, and cytokines • Smooth muscle contraction	• b_2-agonists/anticholinergics for smooth muscle relaxation • Anti-IgE Ab to prevent activation
Eosinophils	• Late phase allergen response • Release of major basic protein (MBP), eosinophilic cationic protein (ECP), leukotrienes • Airway narrowing and hyperactivity, and mucous secretion • Leads to airway remodeling	• Leukotriene receptor antagonists (mast cells and eosinophil action)
T cells	• Initiation and sustaining airway inflammation • Th2 immune deviation (IL-4, 13) leading to ↑ IgE production by B lymphocytes	• Corticosteroids to inhibit proinflammatory cytokines

Lung Cancer

- Most common cause of cancer-related death in both sexes
- 85% occur in smokers (asbestos exposure + smoking ↑ risk).
- Classified as small cell lung cancer (SCLC) and non-small cell lung cancer (NSCLC) (Table 21.26)

TABLE 21.26 • Classification of lung cancers

Cancer and Staging	At Dx (%)	Definition	Treatment	Median/5 yr Survival
Small cell	25%	Usually presents as disseminated, but often chemoradiation sensitive		
Limited		One side of chest within one radiation field	Radiation and chemo ± prophylactic cranial irradiation	1–2 yr
Extensive		Beyond one radiation field	Chemo	1 yr
Nonsmall cell	75%	Adenocarcinoma (35%) Squamous cell carcinoma (30%) Large cell carcinoma (10%)		
I	10%	Isolated lesion and size	Surgery ± chemo	5 yr/40%–50%
II	20%	Hilar node involvement	Surgery ± radiation chemotherapy	1.5–3 yr/25%–35%
IIIA	15%	Mediastinal spread but resectable	Neoadjuvant chemo ± radiation, then surgical resection	1 yr/5%–20%
IIIB	15%	Unresectable		
IV	40%	Metastatic	Chemo and/or supportive care Palliative radiation	0.5 yr/2%

- TNM staging to classify treatment and prognosis in NSCLC
- Staging of SCLC by CT chest, abdomen, bone scan, and CT/MRI brain; further imaging indicated in NSCLC only if clinical Sx suggest metastatic dz
- Regional spread is associated with pleural effusions, tracheal obstruction, hoarseness, dysphagia, Pancoast syndrome (common in apical tumors, involves brachial plexus, causes shoulder pain), SVC syndrome (common in central tumors, leads to SVC compression, dyspnea, venous distension of neck, and swelling of face)
- Metastases common to brain, bone, liver, adrenal, skin
- Paraneoplastic syndromes: Cushing (SCLC), hypercalcemia (squamous), SIADH (SCLC)

PLEURAL EFFUSION / PLEURAL ABNORMALITIES

MCC OBJECTIVE

Based on Objective #76 (Pleural Effusion) of *Objectives for the Qualifying Examination*, 3rd edition.

Pleural Effusion

- Signifies an imbalance between the formation and removal of pleural fluid.
- This can result from pulmonary, pleural, or extrapulmonary dz.
- Most common Sx is dyspnea; less commonly is cough, chest pain, or orthopnea.

CAUSAL CONDITIONS (Table 21.27)

TABLE 21.27 • Exudative versus transudative Pl Eff

Exudative (DELII MICE)	Transudative
• Results primarily from inflammation in lung/pleura or impaired lymphatic drainage, including movement of fluid from extrathoracic spaces • Local factors	• Imbalance of hydrostatic and oncotic pressures in the chest, including movement of fluid from extrathoracic spaces (peritoneal/retroperitoneal) • Systemic factors

• **D**rugs (amiodarone, nitrofurantoin, cytotoxic)
• **E**xtrapulmonary
• **L**ymphatic abnormalities
• **I**nfectious[a]
  • Empyema
  • Parapneumonic
  • Abscess
  • TB
• **I**nflammatory
  • Pancreatitis
  • PE
  • Sarcoidosis
  • Radiation
  • ARDS
  • Asbestos
  • Uremic pleurisy
• **M**alignancy[a]
  • Carcinoma
  • Lymphoma
  • Mesothelioma
  • Chylothorax
• **I**atrogenic
• **C**onnective tissue dz
• **E**ndocrine
	• CHF[a]
	• Cirrhosis
	• Nephrotic syndrome
	• Peritoneal dialysis
	• Hypoalbuminemia
	• Constrictive pericarditis
	• Atelectasis
	• SVC obstruction
	• Urinothorax
	• Meig syndrome

[a] Most common in children.

ASC box

- Pleural fluid has low protein concentration (< 2 g/dL); pH and glucose similar to that of blood.
- Is formed primarily from the parietal pleura. Turnover of fluid depends on vascular and interstitial fluid exchange.
- Hydrostatic pressure of the parietal pleura is 30 cm H_2O (similar to systemic circulation), whereas hydrostatic pressure of the visceral pleura is similar to that of the pulmonary circulation (10 cm H_2O). The fluid therefore moves from parietal toward visceral pleura.
- Oncotic pressure is similar in both (25 cm H_2O).

CLINICAL box

Light's Criteria for Exudates

- Pleural fluid protein divided by serum protein > 0.5
- Pleural fluid LDH divided by serum LDH > 0.6
- Pleural fluid LDH > two-thirds the upper limits of normal serum LDH
- Presence of any of these three criteria makes the pleural effusion exudative.

APPROACH (Figure 21.7)

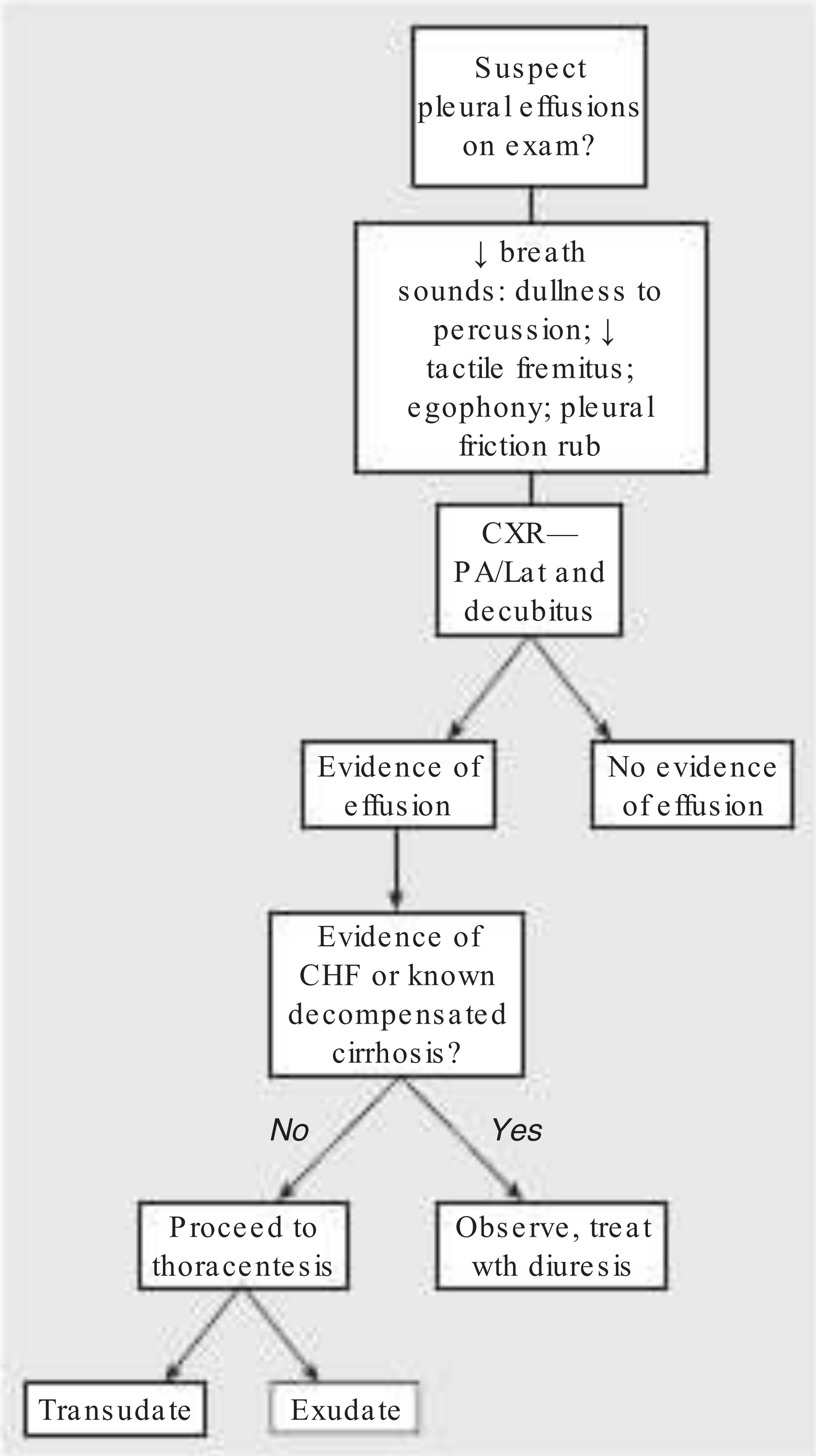

Suspect pleural effusions on exam?
↓ breath sounds: dullness to percussion; ↓ tactile fremitus; egophony; pleural friction rub
CXR—PA/Lat and decubitus
Evidence of effusion
No evidence of effusion
Evidence of CHF or known decompensated cirrhosis?
No
Yes
Proceed to thoracentesis
Observe, treat wth diuresis
Transudate
Exudate

Figure 21.7. Approach to pleural effusions.

Thoracentesis

For analysis of pleural fluid, see Table 21.28

TABLE 21.28 • Analysis of pleural fluid

pH < 7.3	Glucose Level < 1.66 mmol/L	Glucose > 1.66 and < 2.77 mmol/L	Bloody Pleural Effusions
Malignancy TB Empyema Complicated parapneumonic effusion Esophageal rupture Rheumatoid pleurisy	Empyema Rheumatoid pleurisy	Malignancy TB pleuritis Esophageal rupture Lupus pleuritis	• Hemothorax Defn: Hct pleural fluid ≥0.5 Hct serum • Iatrogenic • Trauma • Rib fracture ◦ Ruptured AVM ◦ Dissecting AA • Requires drainage urgently • Bloody pleural effusion • Malignancy • Mesothelioma • PE • Benign asbestos • Post-op cardiac Sx • Postcardiac injury

CLINICAL box

Thoracentesis Relative Contraindications and Complications

Contraindications

- Bleeding diathesis
- Anticoagulation
- Small volume pleural fluid
- Mechanical ventilation
- Active skin infection

Complications

- Pneumothorax (10%)
- Reexpansion pulmonary edema
- Hemothorax/bleeding
- Infection
- Abdominal puncture

CLINICAL box

Indications for CT Scan

- Parapneumonic effusion not responding to abx
- Suspicion of lung malignancy
- Suspected loculated effusion

CLINICAL box

Common Tests for Pleural Fluid Analysis

Pleural Fluid

- LDH
- Total protein
- Glucose
- pH
- Cell count
- Differential
- Cytology (Gram stain)

Serum

- LDH
- Total protein
- Glucose

Rare

- Amylase
- Chylomicrons
- Triglycerides
- AFB smear and culture (yields Dx ~40% of cases)
- Creatinine
- NT-pro-BNP (in select centers for heart failure)

See Table 21.29 for pleural effusion in the setting of pneumonia

TAbl E 21.29 • Pleural effusions in setting of pneumonia

	Definition	Treatment
Uncomplicated	Culture negative Free flowing pH > 7.2	Observe if < 10 mm, clinically stable or improving, no loculation seen
Complicated	Does not resolve with abx alone, pH < 7.2 or loculated and culture negative	Chest tube
Empyema	pH < 7.2 Culture positive or Gram stain ± pus	Chest tube

PNEUMOTHORAX

MCC ObjECTiv ES

Based on Objectives #14 (Chest Pain) and #27 (Dyspnea) of *Objectives for the Qualifying Examination*, 3rd edition.

Ov Er v iEw

- Air in pleural space
- Tension pneumothorax
  - Rapid, labored breathing, cyanosis, tachycardia, hypotension, tracheal shift away from side of pneumothorax, absent breath sounds on the ipsilateral side, JVP distended, pulsus paradoxus, abdominal distention
  - Suspect in patients on mechanical ventilation or noninvasive ventilation with sudden deterioration
- Spontaneous pneumothorax
  - May have variable degree of Sx, depending on size, which can include dyspnea, chest pain
  - Classified into primary (no known cause) and secondary pneumothorax (Table 21.30)

TAbl E 21.30 • Secondary pneumothorax

Category	Causes
Airway dz	Emphysema/COPD, cystic fibrosis, severe asthma
Infectious lung dz	Pneumocystis jiroveci pneumonia, necrotizing pneumonia
Interstitial lung dz	IPF, pulmonary Langerhans cell histiocytosis, sarcoidosis, lymphangiomyomatosis (LAM)
Connective tissue disorder	Marfan syndrome, rheumatoid arthritis, ankylosing spondylosis, Ehlers-Danlos syndrome
Malignancy	Lung cancer, metastatic dz
Trauma/iatrogenic	

APPROACH (Figure 21.8)

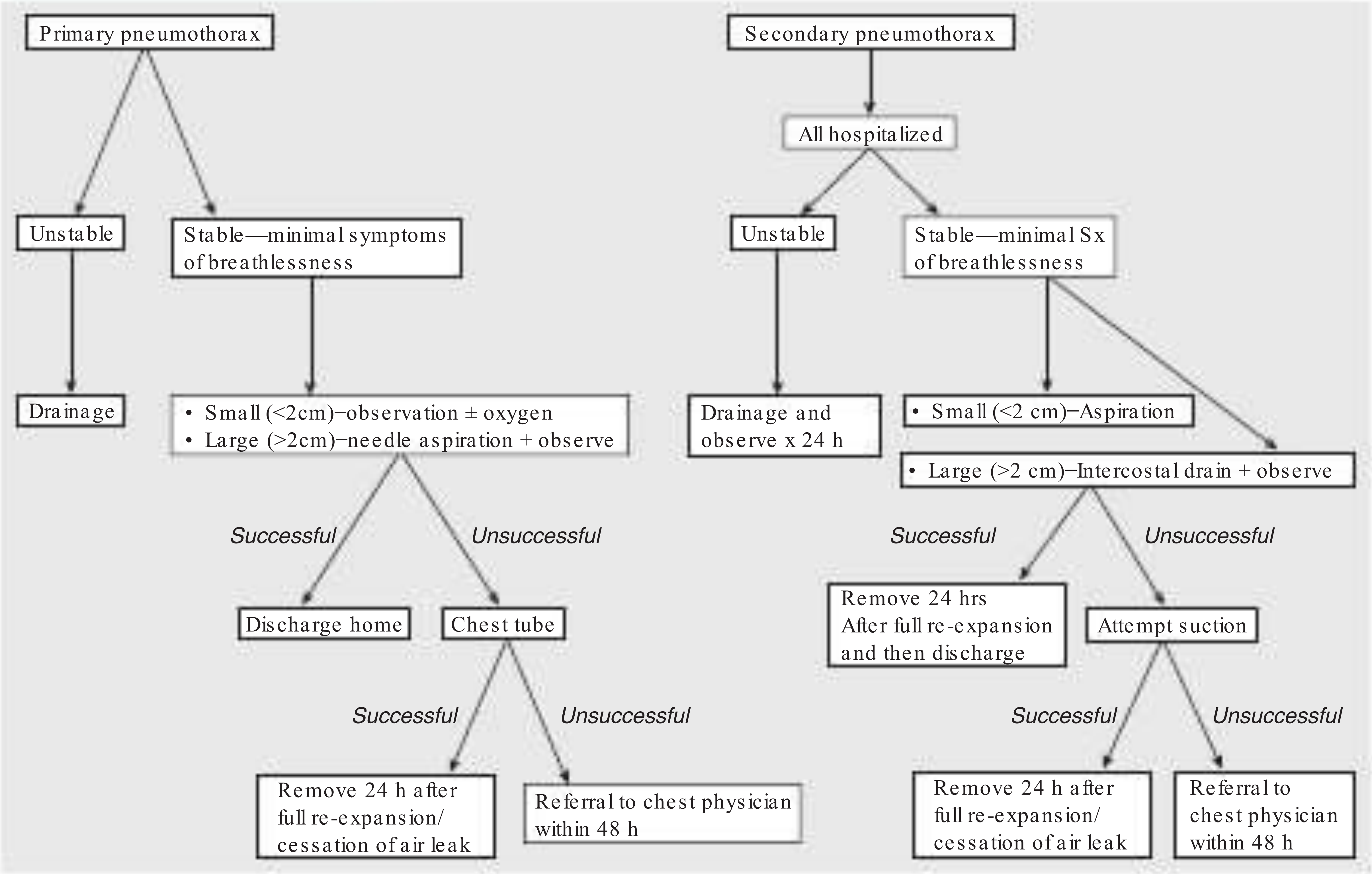

Primary pneumothorax
Unstable
Stable—minimal symptoms of breathlessness
Drainage
• Small (<2cm)–observation ± oxygen
• Large (>2cm)–needle aspiration + observe
Successful
Unsuccessful
Discharge home
Chest tube
Successful
Unsuccessful
Remove 24 h after full re-expansion/ cessation of air leak
Referral to chest physician within 48 h
Secondary pneumothorax
All hospitalized
Unstable
Stable—minimal Sx of breathlessness
Drainage and observe x 24 h
• Small (<2 cm)–Aspiration
• Large (>2 cm)–Intercostal drain + observe
Successful
Unsuccessful
Remove 24 hrs After full re-expansion and then discharge
Attempt suction
Successful
Unsuccessful
Remove 24 h after full re-expansion/ cessation of air leak
Referral to chest physician within 48 h

Figure 21.8. Approach to pneumothorax.

UNILATERAL / LOCAL EDEMA

MCC OBJECTIVE

Based on Objective #29-2 (Localized Edema) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Thrombosis is a common problem. Approximately 70% of patients with PE have asymptomatic DVT.
- Case fatality rates range from 1% to 5%.
- Postthrombotic syndrome (chronic pain, swelling, ulceration of skin) can occur in up to one-third of patients with DVT, with latency up to as late as 10 yr.
- Thrombi that result in clinically significant PE are almost always located in the proximal veins of the legs, but can also begin as calf vein thrombi that extend proximally.

CAUSAL CONDITIONS

Conditions that can mimic DVT:

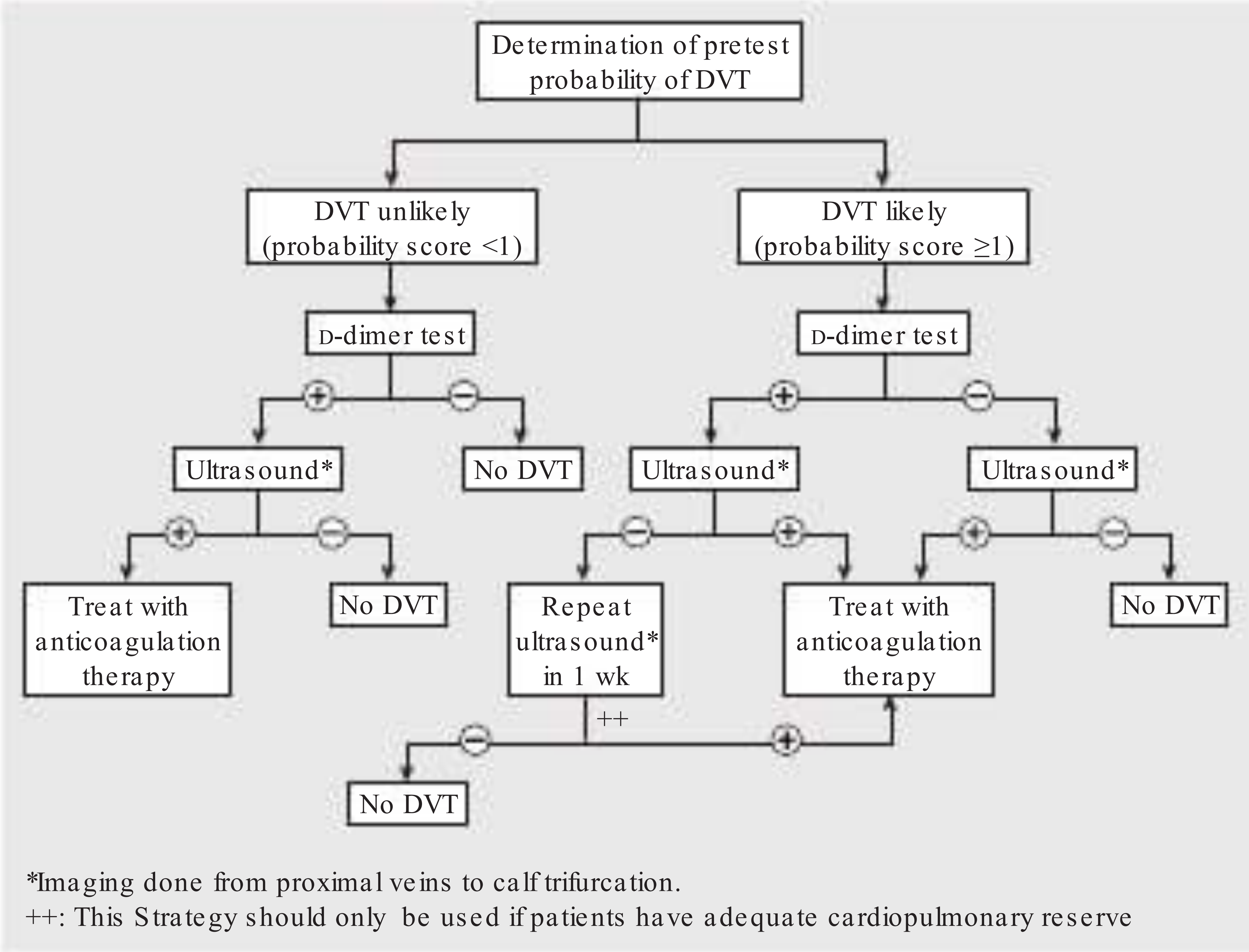
- Lymphatic obstruction
- Ruptured popliteal cyst
- Cellulitis
- Postphlebitic syndrome
- Trauma
- Thyroid dz

!

DVT may be a presenting feature of malignancy.

Malignancy is found most often in patients without obvious cause for DVT, recurrent idiopathic thrombosis, and in patients older than 60.

APPROACH (Figure 21.9)


Determination of pretest probability of DVT
DVT unlikely (probability score <1)
DVT likely (probability score ≥1)
D-dimer test
D-dimer test
+
−
+
−
Ultrasound*
No DVT
Ultrasound*
Ultrasound*
+
−
−
+
+
−
Treat with anticoagulation therapy
No DVT
Repeat ultrasound* in 1 wk
Treat with anticoagulation therapy
No DVT
++
−
+
No DVT

*Imaging done from proximal veins to calf trifurcation.
++: This Strategy should only be used if patients have adequate cardiopulmonary reserve

Figure 21.9. Approach to DVT.

CLINICAL BOX

Establish Risk Factors for DVT

- Pregnancy
- Malignancy
- Hip surgery
- Major knee surgery
- Immobilization
- Oral contraceptives
- Nephrotic syndrome
- Sepsis
- Anticardiolipin Ab
- Proteins C and S and antithrombin deficiency
- Previous VIE

History

- Triad of calf pain, edema, pain on dorsiflexion of foot (Homan sign)—one-third of patients
- If suspicious for PE (dyspnea, pleuritic chest pain, RR > 20, cough, hemoptysis), consider more objective testing
- Often asymptomatic

Well's Criteria for DVT (Tables 21.31 and 21.32)

TABLE 21.31 • Well's criteria for DVT

Sx	Score
Active cancer (ongoing treatment, Dx within 6 mo, palliative care)	1
Paresis, paralysis, or recent plaster cast	1
Recently bedridden for > 3 d and/or major surgery within 4 wk	1
Localized tenderness over distribution of deep veins	1
Entire leg swollen	1
Calf swelling > 3 cm compared with asymptomatic side, measured at 10 cm below tibial tuberosity	1
Pitting edema (greater in symptomatic leg)	1
Collateral superficial veins (nonvaricose)	1
Alternative Dx as likely or greater than that of DVT	–2

TABLE 21.32 • Well's pretest probability of DVT

Score	Risk	Probability
0	Low	3%
1–2	Moderate	17%
> 3	High	75%

Well's Criteria for PE (Tables 21.33 and 21.34)

TABLE 21.33 • Well's criteria for PE

• Clinical signs or Sx of DVT • PE as likely as alternative Dx	3 pts
• HR > 100 bpm • Immobilization or surgery within 4 wk • Prior DVT or PE	1.5 pts
• Hemoptysis • Malignancy	1.0 pt

TABLE 21.34 • Pretest probability for PE

Pts	Risk	Probability
0–2 pts	Low	3%
2–6 pts	Intermediate	20%
> 6 pts	High	60%

Lab Investigations

- CBC, electrolytes, INR, PTT, ABG, CXR, ECG, d-dimer
- Specialist should be consulted prior to CT scan or bronchoscopy in setting of massive or recurrent hemoptysis.

Management of DVT/PE

- Heparin—works immediately by inhibiting activated coagulation factors (Table 21.35)

TABLE 21.35 • Unfractionated heparin versus LMWH

Unfractionated Heparin	LMWH
Inhibits both thrombin and factor Xa	Inhibits specifically factor Xa
Requires frequent monitoring of PTT	Does not require monitoring
Difficult to maintain therapeutic range	More reliable dose relation Lower incidence of thrombocytopenia Can be administered in community
Needs hospitalization, rapidly reverses	Not safe in renal failure, may be difficult to dose in obese patients, not easily reversed

- Coumadin—works slowly by inhibiting synthesis of vitamin K-dependent coagulation factors
- Need to follow INR with target of 2.0 to 3.0

Indications for Anticoagulation

- If DVT or PE is suspected, anticoagulation with heparin or LMWH should be administered until diagnostic evaluation is complete.
- Warfarin (Coumadin) should be administered for long-term anticoagulation use but needs to be overlapped with heparin for a minimum of 5 days, and until INR is therapeutic (2.0 to 3.0)
- Length of treatment
  - VTE after time-limited factor (surgery, transient immobilization)—treat for 3 mo
  - Idiopathic DVT/PE—treat for 6 mo
  - If ongoing risk factors (immobility, cancer, multiple risk factors), second event—treat for life
- Complications: bleeding, thrombocytopenia (HIT) with use of heparins, osteoporosis with long-term LMWH, drug interactions with warfarin, teratogenicity with warfarin
- Thromboprophylaxis recommended prior to surgeries (Table 21.36)

TABLE 21.36 • Thromboprophylaxis

Risk	Situation	Prophylaxis
Low 0.4% DVT 0.2% PE	• Minor surgery in patients < 40 yr with no risk factors	• Early ambulation
Moderate 2%–4% DVT 1%–2% PE	• Minor surgery in patients with risk factors • Minor surgery in patients aged 40–60 with no risk factors	• Low-dose unfractionated heparin 5,000 U q12h • LMWH—dalteparin 2,500 U daily or enoxaparin 20 mg daily. • Intermittent pneumatic compression stockings
High 4%–8% DVT 2%–4% PE	• Surgery in patients > 60 yr with no risk factors • Surgery in patients aged 40–60 with risk factors	• Low-dose unfractionated heparin 5,000 U q8h • LMWH—dalteparin 5,000 U daily or enoxaparin 40 mg daily • Intermittent pneumatic compression stockings + elastic stockings
Very high 10%–20% DVT 4%–10% PE	• Surgery in patients > 40 yr with multiple risk factors • Hip or knee arthroplasty • Major trauma • Acute spinal cord injury	• LMWH—dalteparin 5,000 U daily or enoxaparin 40 mg daily • Oral dose of Coumadin (INR 2–3) • Intermittent pneumatic compression stockings/ elastic stockings + low-dose heparin/LMWH

CLINICAL BOX

Cellulitis as a possible cause of unilateral leg swelling

Cellulitis is a bacterial infection that affects the skin. It presents as acute and progressive onset of hot, swollen, red area of the skin. It is a part of the differential of unilateral leg swelling because it commonly occurs in the lower extremities and is rarely bilateral however it can also present anywhere on the skin.

Classification	Definition	Treatment
Mild	Typical cellulitis without signs of systemic infection	Oral antibiotics • Penicillin or • Ceftriaxone or • Cefazolin or • Clindamycin
Moderate	With systemic signs of infection	Systemic antibiotics (IV) • Penicillin or • Ceftriaxone or • Cefazolin or • Clindamycin
Severe	Severely decompensated or immunocompromised	Rule out necrotizing process, send for cultures, and start empiric broad spectrum systemic antibiotics (IV) • Vancomycin + Piperacilin/ Tazobactam

RESPIRATORY ALLERGY

MCC OBJECTIVE

Based on Objective #4 (Allergic Reactions and Atopy) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Text starting with Allergic Reactions can be placed here

Allergic Reactions

- Information on allergic reactions can be found under various topics in this book.
- This chapter considers the topics together, as people with allergic rhinitis or atopic dermatitis have an ↑ likelihood of developing asthma or resp atopy.
- Atopy is a genetic condition resulting from hypersensitivity reactions to allergens.
- Also see Food Allergy in Chapter 7 and Anaphylaxis in Chapter 5

APPLIED SCIENTIFIC CONCEPTS

Mast Cells

- Have very high affinity receptor for IgE on surface (coated with IgE Ab)
- When allergen binds to IgE on surface of mast cell, get cross-linking leading to activation of the mast cell
- Activation leads to release of preformed mediators (stored in granules) such as histamine, proteoglycans (heparin) and serine proteases.
- Activated mast cells make and release prostaglandin D_2, leukotriene C_4, and cytokines.

Histamine Causes

- Dilatation of postcapillary venules
- Bronchial and smooth muscle contraction
- An ↑ in nasal mucus production
- ↑ in blood vessel permeability, leading to edema

ASSOCIATED CONDITIONS (Table 21.38)

TABLE 21.38 • Allergies

Generalized (see Anaphylaxis in Chapter 5)	
Localized	
Skin (see Chapter 4)	• Dermatitis/atopy/pruritus • Urticaria • Angioedema
Resp	• Rhinorrhea • Wheezing
Gastrointestinal tract	• Food intolerance • Celiac dz

APPROACH

The approach to atopy and allergy largely depends on the severity of the reaction. Common allergy-associated conditions and management are outlined below. Education is the most important intervention.

- Read food labels
- Avoid high-risk situations such as buffets
- Wear medic-alert bracelet
- May need self-injectable adrenaline (especially if previous allergic reaction resulting in respiratory or cardiovascular effects, but may want to have if peanut or tree nut allergy, if an allergic reaction has occurred to a small trace of allergen, or if individual is far from medical care)
- Know the early warning signs of allergic reaction

Allergic Rhinitis

See also Rhinorrhea in Chapter 17

- Characterized by sneezing, itchy eyes, rhinorrhea
- Due to the inhalation of air borne antigens to which patient has been previously sensitized (and has made IgE Ab)
- Very common cause of physician visits and lost days from school and work
- Up to 50% of patients with asthma and up to 30% of patients with eczema have allergic rhinitis.
- Careful history to elicit likely allergen, seasonal, perennial, or occupational features

CLINICAL BOX

Common Food Allergies

- Peanuts
- Tree nuts
- Eggs
- Cow's milk
- Wheat
- Fish
- Shellfish
- Sesame

CLINICAL BOX

Other Common Allergies

- Drugs (abx)
- Insect venom
- Radiocontrast media
- Latex

- Rhinitis can also be due to infectious causes, perennial nonallergic causes, and others such as hormonal (pregnancy, hypothyroid), drug-induced, associated with food, or mechanical causes.
- May treat with nasal steroids and/or antihistamines

Angioedema

- Rapid swelling of skin, mucosa, and submucosal tissue
- Commonly associated with allergy (to foods or drugs such as ACE inhibitors), but exists in an hereditary form
- If rapidly progressing, requires emergency management (see Anaphylaxis in Chapter 5)

Wheezing

- Differential Dx of wheeze includes:
  - Asthma
  - Foreign body
  - Aspiration
  - GERD
  - Cystic fibrosis
  - Bronchitis
  - Tumor
  - COPD
- Atopy is a predictor of persistent asthma.
- Take a history to elicit family history of atopy and physical exam to look for atopic dermatitis
- Can do skin prick testing to identify allergen

Atopic Dermatitis

Chronic inflammatory skin condition (see Allergy section in Chapter 4)

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CHAPTER

22

Rheumatology

Daniel Ennis • Jane Hsieh • Kun Huang

Table of Contents

Inflammatory Arthritis
Mechanical Joint Pain
Nonarticular Musculoskeletal Pain
Generalized Pain Syndromes and Myopathies

INFLAMMATORY ARTHRITIS

MCC OBJECTIVES

Based on Objectives #50-1 (Oligoarthralgia [Pain in One to Four Joints]), #50-2 (Polyarthralgia [Pain in More Than Four Joints]), and #117 (Weakness, Paralysis, Paresis, and/or Loss of Motion) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

The conditions that cause oligoarthralgia (pain in one to four joints) are mostly the same as the conditions that cause polyarthralgia (pain in more than four joints). However, infectious and crystal-induced causes of arthritis should be considered higher on the differential for acute monoarthritis (pain in one joint). The most serious condition that needs to be considered in monoarthritis is septic arthritis due to the risk of permanent joint destruction. For this reason, acute monoarthritis is treated as septic arthritis until proven otherwise. In polyarthralgia, particularly lasting >6 wk, rheumatic causes should be considered higher on the differential.

APPLIED SCIENTIFIC CONCEPT

Below are select high-yield causes of inflammatory arthritis and important points about each.

Infectious

- Septic arthritis: infection of joint space from hematogenous spread or open injury
  - Most common organisms are *Staphylococcus* or *Streptococcus*
  - Suspect gonococcal arthritis in sexually active adults

Autoimmune Causes

- The etiology of arthritis in autoimmune diseases is largely unknown; however, environmental and genetic factors have been implicated.
- Seropositive arthropathies: characterized by the presence of RF in the blood (e.g., SLE, RA).
- Seronegative arthropathies: characterized by the absence of RF, and associated with a predilection for spinal and sacroiliac inflammation (AS, PsA, ReA, and EA) (Table 22.1).

Crystal Induced

- Gout: acute inflammatory response to uric acid crystals in the joint accompanied by an elevated serum uric acid level and rapid change in uric acid concentration
  - Uric acid overproduction: nutritional (meat, seafood, EtOH), heme malignancy
  - Uric acid underexcretion: dehydration, renal failure, diuretics

TABLE 22.1 • Seropositive versus seronegative autoimmune arthritis

	Seropositive	Seronegative
Gender	Female preponderance	Male preponderance
Spinal/sacroiliac involvement	–	+ A key feature Low back pain is common.
Pattern of peripheral joint involvement	Symmetrical Multiple joints MCP/PIPs DIPs not usually involved	Usually asymmetrical, oligoarticular, below the waist (exception in PsA with DIP involvement)
Enthesitis	–	+
Common extra-articular features	Raynaud phenomenon Sicca Nodules	Iritis/uveitis Oral ulcers Cutaneous involvement Gastrointestinal issues
Association with HLA-B27	–	+

- CPPD (also known as pseudogout): acute inflammatory arthritis due to phagocytosis of IgG-coated calcium pyrophosphate crystals by neutrophils and subsequent release of inflammatory mediators within the joint space

CAUSAL CONDITIONS (Figure 22.1)

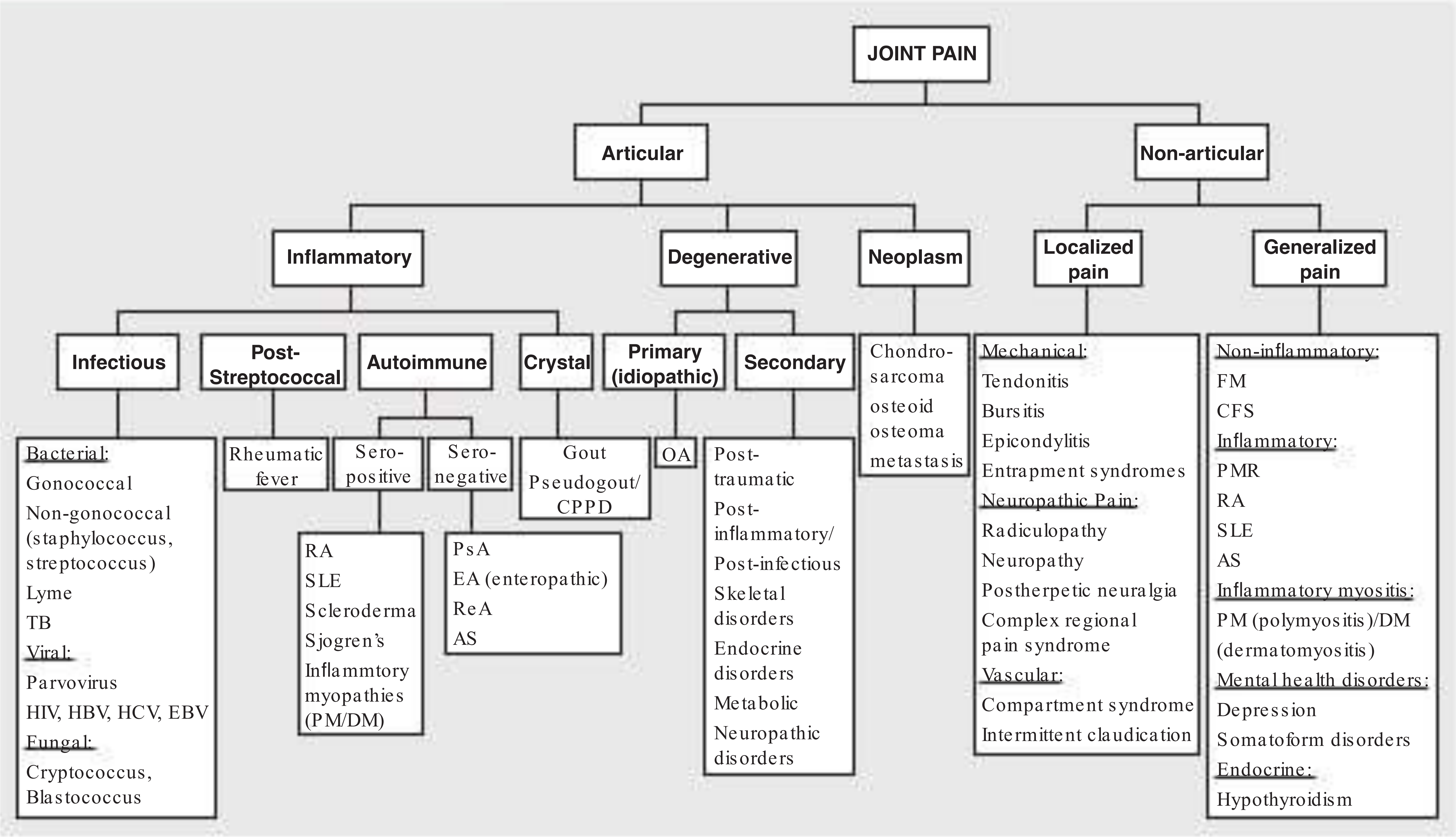

Figure 22.1. Joint pain.

APPROACH

History

- OPPQRST (**O**nset, **P**rovoking/**P**alliating factors, **Q**uality, **R**adiation, **S**everity, **T**iming)
- Acute arthritis (<6 wk) versus chronic (>6 wk):
    - Acute oligoarthritis presents as a rapidly swelling joint with severe pain and restricted ROM within minutes to days. The patient can usually pinpoint the

  exact onset of symptoms. Chronic, or subacute, oligoarthritis has a more insidious onset that lasts from week to months.
  - Acute pain could point to infectious or autoimmune disease, but chronic pain would increase the likelihood of the latter.
- Oligo versus polyarthritis:
  - Systemic diseases such as RA, SLE, EA, PsA, and ReA can all begin as inflammation in one joint. Evaluating patients for underlying systemic diseases can lead to early diagnosis of a systemic etiology.
  - Monoarthritis can progress from one joint to few joints (oligo) then to many joints (poly).
- Infectious features:
  - History of fever, sexual history, sick contacts, IVDU, diabetes, RA, recent joint surgery, hip or knee prosthesis.
  - Lyme disease: travel to Lyme-endemic regions (the northeastern United States, Midwestern states, northern California), history of rash (erythema migrans), history of tick bite.
- Poststreptococcal arthritis (i.e., rheumatic fever):
  - History of sore throat, fever.
  - "No rheum for SPECCulation"; **S**ubcutaneous nodules, **P**olyarthritis, **E**rythema marginatum, **C**horea, **C**arditis.
- Postinfectious features:
  - Preceding GI/GU illness (diarrhea, urethritis)
  - Involving mostly the joints of the lower extremity
  - Enthesitis/dactylitis is common.
- Crystal arthropathy features:
  - History of gout, renal insufficiency, diuretic use, HTN, obesity, high-purine diet, heavy alcohol use
- Inflammatory features:
  - Morning stiffness (>30 min to 1 h)
  - History of joint swelling, erythema, warmth
  - Decreased ROM of affected joints
  - Pain at rest, relief with movement
- Noninflammatory features:
  - Morning stiffness <30 min
  - Symptoms worse with activity
  - Swelling may or may not be present.
  - Also see Mechanical Joint Pain section that follows

clinical box

Reactive Arthritis

Triad of:

Can't see (conjunctivitis)
Can't pee (urethritis)
Can't climb a tree (arthritis)

Physical Exam

- Check **vitals** for signs of sepsis (fever, tachycardia, increased respiratory rate)
- **H&N:** look for malar/discoid rash, oral ulcers, alopecia (SLE); telangiectasias, tight skin around the mouth, sicca (Sjögren's); uveitis, conjunctivitis (seronegative disease/reactive arthritis)
- **Respiratory:** crackles, wheeze, evidence of pleural effusions (SLE/RA)
- **CVS:** distant heart sounds/pericardial rubs (SLE/RA); asymmetric blood pressure/bruits (vasculitis); murmur (rheumatic fever)
- **Dermatologic:** overlying skin infection (LR 2.8 for septic arthritis), psoriasis, pitting nails (psoriatic arthritis); shawl sign, V-sign, holster sign, periungual erythema, heliotrope rash, Gottron papules (DM); nodules (RA); tophi (gout); erythema migrans (Lyme); erythema marginatum (rheumatic fever); erythema nodosum (enteropathic arthritis); telangiectasia (scleroderma/CREST)
- **MSK:**
  - Arthritis versus periarticular disease: warmth (calor), swelling (tumor), tenderness (dolor), and erythema (rubor) surrounding the joint coupled with painful ROM in all planes with loss of function (functio laesa) suggest articular disease. Retention of normal joint motion or pain limited to one movement and one location suggests soft tissue disorders such as bursitis, cellulitis, or tendonitis.
  - RA: symmetric joint involvement, swan neck deformity, Boutonnière deformity, ulnar deviation of MCP, and radial deviation of wrist.
  - For differences between RA and OA, see Figure 22.2.
  - Dactylitis and enthesitis (reactive or psoriatic arthritis).

- Special tests if back involvement:
  - **Gaenslen test:** patient lies near the edge of table and hangs one leg over the side while flexing the other hip and knee against the chest. If pain ↑ in buttock region of leg hanging over the edge of the table, indicative of SI joint inflammation/pathology.
  - **FABER Test: F**lexion, **A**bduction, **E**xternal **R**otation at the hip. Pain in the buttock is suggestive of SI joint inflammation.
  - **Modified Schober test:** evaluate the degree of movement in the lumbar spine with forward flexion. Make the patient stand in upright position with back exposed. Mark the skin 10 cm above the dimples of Venus, then ask the patient to flex forward to touch his or her toes (extension at knees). An ↑ of <4 cm between the mark and the dimples of Venus suggests spine immobility (i.e., AS).
  - **Chest expansion:** a limitation in chest expansion of 2 cm or less when measuring around the chest at nipple level is pathognomonic for spondylitis.
  - **Occiput to wall distance:** the patient stands with his or her back to the wall and heels touching the baseboard. Measure the distance between the occiput and the wall—it should be zero. Serial measurements are helpful in evaluating kyphotic disease progression.

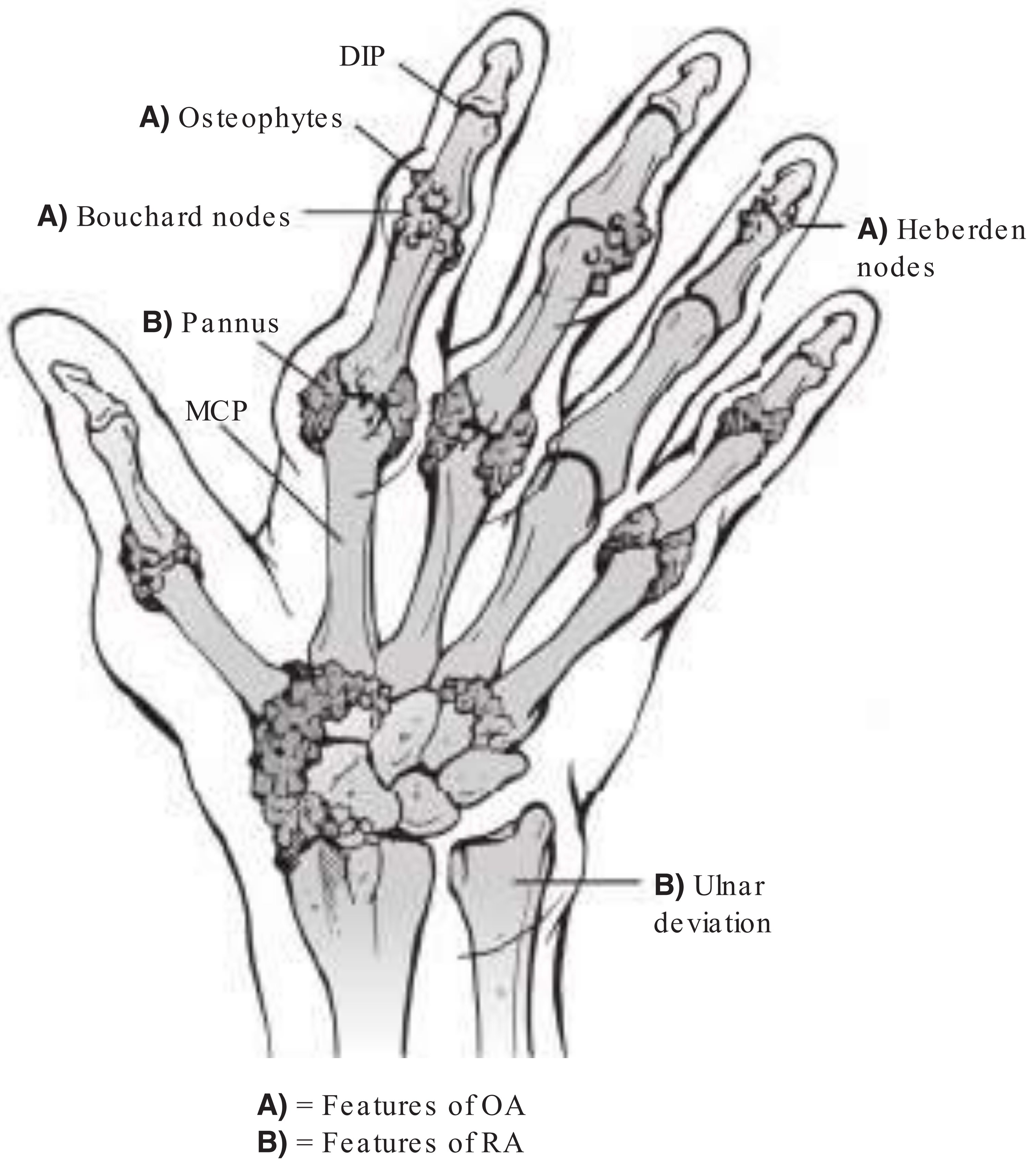

Figure 22.2. RA versus OA on physical exam.

Investigations

- Joint aspiration and synovial fluid analysis—send for the 4 Cs: **C**ulture, **C**ell count, **C**rystals, **C**hemistry (Table 22.2)
  - Presence of crystals does not rule out septic arthritis.

Additional Investigations

- Uric acid level—Note that hyperuricemia is neither necessary nor sufficient to cause gout
- Blood cultures
- CBC, electrolytes, urea, Cr, INR, PTT, LFTs, urinalysis—can help identify patients with anemia/thrombocytopenia/renal compromise/hepatitis, which may suggest systemic illness
- ESR/CRP—nonspecific; but if elevated, can point to inflammatory process

TABLE 22.2 • Synovial fluid analysis in various conditions

	Normal	Noninflammatory	Inflammatory	Infectious	Hemorrhagic
Appearance	Clear	Clear, yellow	Clear to opaque	Turbid, purulent, serosanguinous	Sanguineous
Viscosity	High (string test)	High	Low	Variable	Variable
WBC/mm^3	<200	<2,000	>2,000	>50,000: LR 7.7 >100,000: LR 28	Variable
PMNs	<25%	<25%	≥50%	<90%: LR 0.34 ≥90%: LR 3.4	Variable
Culture/Gram stain	–	–	–	+	–
Protein	Normal	Normal	↑	↑	↑
Glucose	= to blood	= to blood	↓	↓↓	= to blood
Conditions		OA, Trauma	RA, crystal, CTD, Spondyloarthropathies	Septic arthritis	Traumatic, hemophilia

From Margaretten ME, Kohlwes J, Moore D, et al. Does this adult patient have septic arthritis? JAMA. 2007;297(13):1478–1488. doi:10.1001/jama.297.13.1478.

clinical box

Contraindications and precautions to Nsaids

GI toxicity (dyspepsia, PUD, bleeding), renal insufficiency, advanced hepatic impairment, CHF or HTN, known hypersensitivity, concomitant use of anticoagulants, chronic EtOH abuse, and platelet dysfunction

- Special serologic tests:
  - Consider RF and anti-CCP if RA is suspected
  - Consider ANA, anti-dsDNA, C3 and C4 if SLE is suspected
  - Consider ANCA if vasculitis is suspected
  - Consider HLA-B27 if ankylosing spondylitis is suspected
- STI investigations if suspect gonococcal
- X-ray of affected joint(s)
- Consider x-ray of sacroiliac joints if ankylosing spondylitis or other seronegative disease is suspected
- For laboratory investigations for autoimmune arthritis, see Table 22.3

TABLE 22.3 • Laboratory investigations for autoimmune arthritis

Condition	Laboratory tests	Notes
	ESR, CRP	Nonspecific inflammatory markers
RA	RF	Sens 69%. Associated with other rheumatologic disorders and also seen in healthy patients Not specific for RA
	Anti-CCP	Sens 85%, spec 95% When present, suggests RA
SLE	ANA	Sens >99%, but nonspecific Can help exclude SLE Also positive in Sjögren's, inflammatory myopathies, RA
	Anti-dsDNA	Most specific test for SLE (spec >95%, sens 20%–30%)
	Anti-Sm	Sens 30%, spec >75% Associated with lupus nephritis
	Antihistone	Associated with drug-induced lupus (sens >90%, very spec)
	C3, C4	Decreased in SLE
Scleroderma	Anti-Scl-70	Seen in 10%–40% of scleroderma patients
	Anticentromere	Associated with CREST syndrome
Sjögren syndrome	Anti-Ro/SSA	Sens 75%. Associated with cutaneous manifestations of SLE, and having a child with neonatal lupus
	Anti-La/SSB	Sens 40%. Rarely detected in absence of anti-Ro/SSA
Inflammatory myopathies (PM/DM)	Anti-Jo-1	Associated with PM
	Anti-MI-2	Associated with DM
	Anti-SRP	Seen in both PM and DM

Diagnosis (Table 22.4)

TABLE 22.4 • Diagnosing inflammatory arthritis

Diseases	Diagnosis
Infectious: GC or non-GC, Lyme disease, rheumatic fever	• Synovial fluid WBC count >50,000/mm^3 points to septic arthritis with usually positive Gram stain and culture • Gonococcus can be difficult to culture
Seropositive spondyloarthropathies	• RA: classification criteria for RA looks at number of swollen or tender joints involved, serology (RF and anti-CCP), acute phase reactants (ESR, CRP), and duration of symptoms that generate a score to assess the likelihood of RA • SLE: (MD SOAP BRAIN: 4 or more of 11 must be present) • **M**alar rash, **d**iscoid rash, **S**erositis, **O**ral ulcers, **A**NA, **p**hotosensitivity, **B**lood disorders, **R**enal involvement, **A**rthritis, **I**mmunologic phenomena, **N**eurologic disorder • Scleroderma (1 major or 2 minor must be present) • Major: scleroderma proximal to MCPs • Minor: sclerodactyly, digital pitting scars/loss of substance from finger pad, bibasilar pulmonary fibrosis • Sjögren syndrome • Diagnosis depends on sicca symptoms and signs, salivary gland biopsy, and autoantibodies (anti-Ro, anti-La, ANA, RF) • Inflammatory myopathies • Symmetric proximal muscle weakness typically involving shoulder and hip girdles • Elevated CK • EMG changes • Positive muscle biopsy • Typical rash of DM (Gottron papules, heliotrope rash, shawl sign, mechanic's hands, periungual erythema)
Seronegative spondyloarthropathies	• AS • Clinical: low back pain, limitation of lumbar spine motion, limitation of chest expansion • Radiologic: symmetric sacroiliitis • EA: arthritis in the setting of either ulcerative colitis or Crohn disease • PsA: diagnosis is based on characteristic dermatologic (psoriasis, nail involvement), arthritis, and radiologic (syndesmophytes, pencil in cup appearance at DIP joints, osteolysis, periostitis) findings • ReA: joint aspiration will yield aseptic fluid. Diagnosis is based on characteristic MSK findings, history of preceding GI/GU infection
Crystal arthropathies	• Synovial fluid WBC count >2,000/mm^3 • Gout has negatively birefringent, needle-like crystals on synovial fluid analysis. Serum uric acid is not diagnostic. X-ray may show tophi as soft tissue swelling, punched-out lesions-erosion with "overhanging" edge • CPPD has positively birefringent, rhomboid crystals on synovial fluid analysis. X-ray may show chondrocalcinosis (fibrocartilage, articular cartilage, ligaments, joint capsule)

Management (Tables 22.5, 22.6, and 22.7)

TABLE 22. 5 • Managing inflammatory arthritis

Diseases	Treatment
Infectious: GC or non-GC, Lyme disease, rheumatic fever	• IV third-generation cephalosporin (i.e., Ceftriaxone) + joint drainage (for gram-negative septic arthritis) • IV vancomycin + joint drainage (for gram-positive septic arthritis • Doxycycline (Lyme) • Penicillin G (rheumatic fever)
Postinfectious (reactive) arthritis	• NSAIDs, intra-articular steroids if inadequate response to NSAIDs • Antibiotic therapy for Chlamydia if still present
Seropositive spondyloarthropathies	• See Table 22.6
Seronegative spondyloarthropathies	• 1st line: NSAIDs • 2nd line: DMARDs (e.g., methotrexate, anti-TNF inhibitors)
Polyarticular gout	• For acute attack: either NSAIDs, colchicine, systemic, or intra-articular glucocorticoids • Urate lowering therapies after acute gout attack (e.g., allopurinol, febuxostat, probenecid) • Prevention of future attacks: avoidance of alcohol, red meat, shellfish, foods high in purines
CPPD	• NSAIDs/colchicine/systemic or oral glucocorticoids for acute attack

TABLE 22.6 • Indications for various treatments in gout, pseudogout, and septic arthritis

Intervention	Gout	Pseudogout	Septic Arthritis
Antibiotics			+
NSAIDs	+	+	+
Corticosteroids	+ (systemic/ intra-articular)	+	Contraindicated
Allopurinol	+ (not in acute exacerbation)		
Colchicine	+	+	
Other	Purine-restricted diet		Surgical drainage

TABLE 22.7 • Approach to systemic autoimmune rheumatic diseases

	Etiology	Clinical Signs	Investigations	Treatment
RA	Proliferation of synovial tissue forms a pannus, which invades and destroys cartilage and bone M:F = 1:2.5	Morning stiffness (2+ h), warm and swollen joints, joint immobility, structural damage; rheumatoid nodules, 2° Sjögren's, interstitial fibrosis, pericardial abnormalities	Elevated ESR, RF, CRP, and anti-CCP; joint destruction and deformity on x-ray	NSAIDs, corticosteroids, DMARDs (antimalarials, methotrexate, sulfasalazine, leflunomide, gold), biologics (e.g., TNF-α inhibitors)

(Continued)

TABLE 22.7 • Continued

SLE	Autoantibodies bind to proteins to form immune complexes, which deposit in tissues and trigger inflammatory cascade M:F = 1:9	Nonerosive arthritis, photosensitive (butterfly) rash, discoid rash, hematologic disorders (anemia, leuko/lymphopenia, thrombocytopenia), oral ulcers, serositis, renal dysfunction, neurologic disorders, Raynaud phenomenon	CBC, serum Cr, urinalysis, ANA, anti-dsDNA, anti-Sm, antiphospholipid, no erosions on x-ray	NSAIDs, corticosteroids, antimalarials, azathioprine, cyclophosphamide, methotrexate **Note:** antimalarials may cause retinal toxicity, and patients must have yearly eye exams; methotrexate can cause liver toxicity, and LFTs need to be monitored
Systemic sclerosis (scleroderma)	Two types: diffuse (associated with malignant HTN) and limited; fibrosis of the skin with possible visceral organ involvement M:F = 1:3	Raynaud phenomenon, skin changes starting at fingers and toes and extending proximally; tightness, pruritus, pain, flexion contractures, friction rubs; can have interstitial lung disease, heart failure, or arrhythmias, or renal crises	ANA, anticentromere, antitopoisomerase, skin biopsy, Cr, GFR, PFTs, echocardiogram; Scl-70 is associated with ↑ interstitial lung disease	No drugs have been shown to change the course of the disease; Ca^{2+} channel blockers have been used for Raynaud's; physiotherapy and pain management for symptomatic relief
Vasculitis	Inflammatory destruction of blood vessels; neutrophils invade vessel walls and degranulate, leading to scarring and impediment of blood flow	Nonspecific arthralgias, myalgias, neuralgias, small-vessel hemorrhage (lungs, kidneys), or palpable purpura **Wegener's:** medium-vessel, lung involvement, rapidly progressive glomerulonephritis **Henoch–Schönlein purpura:** small-vessel, palpable purpura, arthritis, glomerulonephritis, and abdominal pain **Giant cell arteritis**: see Generalized Pain Disorders	Assess systemic involvement (lung, GI, kidney), biopsy of most accessible organ, ESR, CRP, ANCA (for Wegener's), serum cryoglobulins	Glucocorticoids (prednisone), cytotoxic drugs (azathioprine, cyclophosphamide), rituximab
PM/DM	Muscle inflammation, leading to damage and weakness; 15% association with underlying malignancy in older patients; bimodal distribution (10–15 and 45–60); M:F = 1:2	Myalgias, arthralgias, symmetrical muscle weakness with fatigue, morning stiffness, and anorexia; skin manifestations in DM: Gottron papules, heliotrope rash (eyelids), shawl sign, V-sign, dystrophic cuticles	Elevated ESR and CK; consider possibility of underlying malignancy, particularly in older individuals	Physical therapy, corticosteroids

MECHANICAL JOINT pAIN

MCC OBJECTIVES

Based on Objectives #50-1 (Oligoarthralgia [Pain in One to Four Joints]), #50-2 (Polyarthralgia [Pain in More Than Four Joints]), #50-4 (Back Pain and Related Symptoms [e.g., Sciatica]), and #50-5 (Neck Pain) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEw

Mechanical joint pain is synonymous with degenerative arthritis aka OA. It is the most common, chronic, noninflammatory arthropathy. There is increased prevalence with increasing age.

APPLIED SCIENTIFIC CONCEPT

The pathophysiology of OA is the deterioration of articular cartilage secondary to local biomechanical factors and release of proteolytic and collagenolytic enzymes. Abnormal local bone metabolism can further damage joints. Small effusions (synovitis) can occur in OA due to cartilage damage.

CAUSAL CONDITIONS

Types of OA

- Primary/idiopathic OA is the most common.
- Secondary OA refers to conditions that may cause or enhance the risk of OA. The underlying process of joint damage is the same as in primary OA. These include:
  - Posttraumatic
  - Postinflammatory or postinfectious
  - Skeletal disorders such as scoliosis
  - Endocrine disorders such as hyperparathyroidism, hypothyroidism
  - Metabolic disorders such as gout, pseudogout, hemochromatosis, Wilson disease
  - Neuropathic such as Charcot joints
  - Avascular necrosis

As with inflammatory causes of arthritis (see Causal Conditions in the Inflammatory Arthritis section), other causes of arthritis should be considered and excluded.

APPROACH

History

- Family history of OA, advanced age, female, obesity (especially for knee OA)
- Previous trauma, infections, or crystal arthropathy of the affected joints
- Insidious and progressive pain, intermittent flares, and remissions
- Morning stiffness <30 min, pain worse with motion and relieved with rest

Physical Exam

- Commonly affected joints: weight-bearing joints—cervical and lumbar spine, small joints of the hand (DIPs, first CMC), hips, and knees
- Joint line tenderness; stress pain ± joint effusions
- Bony enlargement of the affected joints (thumb squaring, Heberden node of DIP, Bouchard nodes of PIP)
- Misalignment/deformity
- Limited ROM
- Crepitus on passive ROM
- Mild inflammation (compared to inflammatory arthritis)
- Periarticular muscle atrophy

Investigations

- CBC, ESR (or CRP), and RF or ANA
- X-ray of affected joints
- Synovial fluid aspiration

Diagnosis

- The radiographic hallmarks of OA include joint space narrowing, subchondral sclerosis, subchondral cysts, and osteophytes.
- Synovial fluid analysis, if done, should be consistent with noninflammatory features.
- Laboratory tests and inflammatory markers are typically normal.
- RF and ANA are usually negative.

Management

- Nonpharmacologic treatment
  - Weight loss of minimum 5 to 10 lb
  - Physiotherapy and low impact exercise programs such as water exercises
  - Occupational therapy with aids, splints, cane, walker, and bracing
- Pharmacologic treatment
  - Oral: acetaminophen, NSAIDs, glucosamine (Evidence is controversial.)
  - Joint injections: corticosteroid, hyaluronic acid (questionable benefit)
  - Topical: NSAIDs, capsaicin

- Surgical treatment
  - Joint debridement, total and/or partial joint replacement, fusion

NONARTICULAR MUSCULOSKELETAL PAIN

MCC OBJECTIVES

Based on Objectives #50-3 (Non-Articular Musculoskeletal Pain), #50-4 (Back Pain and Related Symptoms [e.g., Sciatica]), and #50-5 (Neck Pain) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Nonarticular musculoskeletal pain originates from the soft tissue structures surrounding a joint, but not from within the joint itself. It is common, but rarely life threatening. It is often referred to as "soft tissue" pain. Nonarticular musculoskeletal pain can be generalized or local. Due to the broad topics encompassed under this term, we will focus on only localized nonarticular pain in this section. Generalized pain syndromes such as polymyalgia rheumatic and FM will be discussed separately in the next topic.

APPLIED SCIENTIFIC CONCEPT

The precise pathophysiology of most cases of nonarticular musculoskeletal pain is poorly understood, although in some cases a predisposing factor can be identified such as overuse or acute trauma. Given that nonarticular musculoskeletal pain includes a large number of anatomic regions, these conditions can be best approached according to the anatomic region involved in order to help identify the anatomic structure at fault (Figure 22.3).

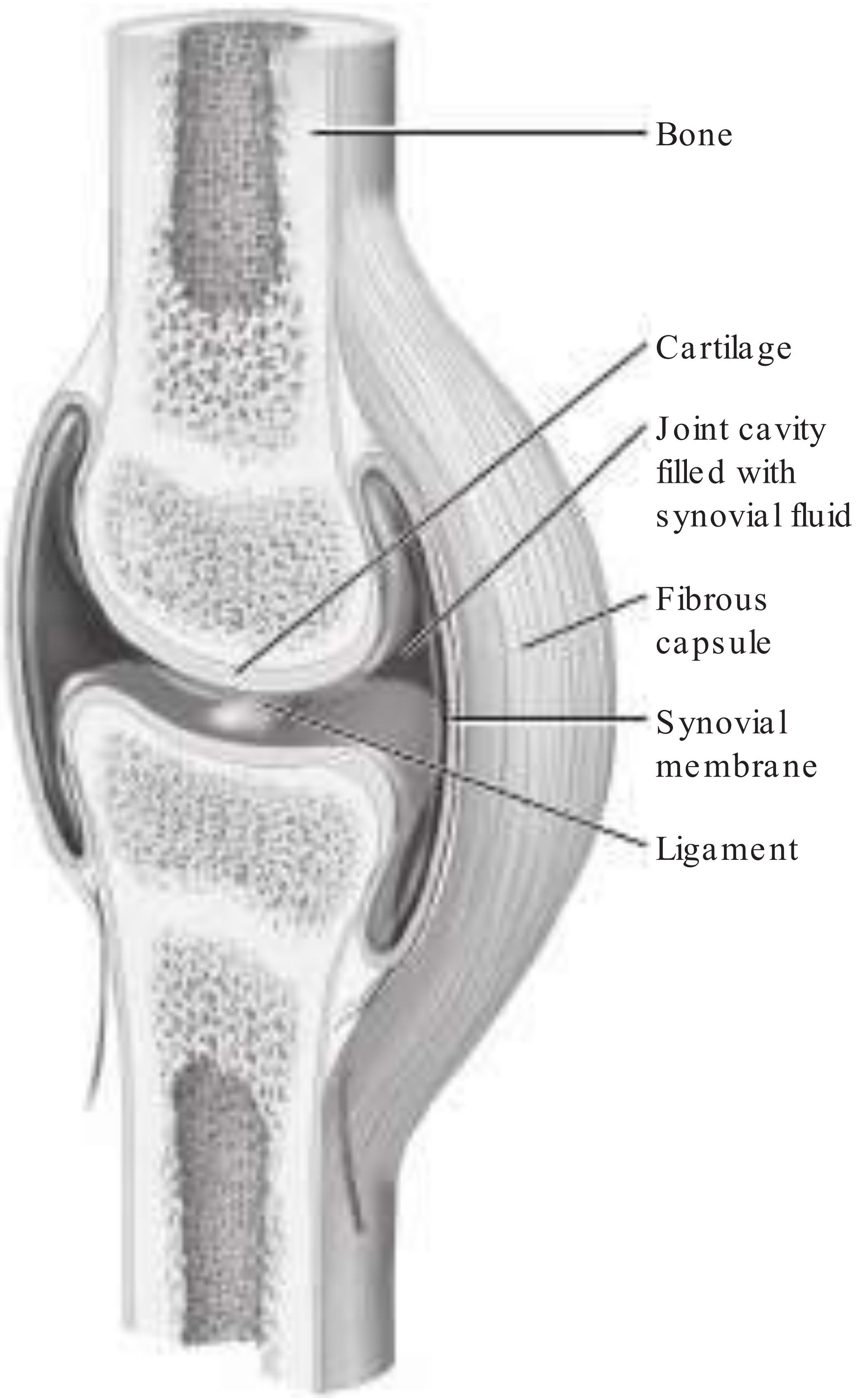

Figure 22.3. Synovial joint. (From Archer P, Nelson LA. *Applied Anatomy & Physiology for Manual Therapists*. Philadelphia, PA: Lippincott Williams & Wilkins; 2012).

CAUSAL CONDITIONS (Table 22.8)

TABLE 22.8 • Causal conditions of nonarticular pain

Mechanical	
Tendonitis	Pain associated with muscle contraction, swelling along the tendon sheath, point tenderness along the tendon
Bursitis	Inflammation in the sac of fluid between tendons, skin, and bone; result from trauma or repetitive motion; common in greater trochanteric bursa, knees, heels, elbows, and shoulders
Epicondylitis	Medial (golfer's elbow) or lateral (tennis elbow); tendonitis of common wrist flexor (medial) or common wrist extensor (lateral)
Entrapment syndromes	Paresthesia with numbness and tingling more than pain. Common sites include the ulnar nerve at the elbow, the median nerve at the wrist (carpal tunnel syndrome)
Neuropathic Pain	
Radiculopathy	Impingement/damage to nerve roots; causes include disk herniation, spondylosis, spondylolisthesis, spinal stenosis, spinal neoplasm ± cauda equine
Neuropathy	Damage to peripheral nerves; causes include infection, diabetes, B_{12} deficiency, neoplasm
Postherpetic neuralgia	Result of infection with herpes zoster May be debilitating
Complex regional pain syndrome (previously known as reflex sympathetic dystrophy)	Persistent burning pain following injury accompanied by swelling, damage to skin and soft tissues, muscle wasting, regional osteopenia, and sweating; type I (peripheral injury) and type II (proximal)
Vascular	
Compartment syndrome	Increased pressure within one of the body's compartments, which causes insufficient blood supply to the surrounding and distal tissues
Intermittent claudication	A sign of peripheral arterial disease in which there is insufficient blood supply to muscle during exercises

APPROACH

History

- Differentiate articular from nonarticular disorders
  - Movement can cause pain in both inflammatory joint and tendonitis/bursitis/tenosynovitis.
  - Both can have swelling or erythema of the overlying skin.
  - A septic joint is more likely when systemic symptoms coexist, and ROM is significantly impaired due to pain.
- Lack of inflammatory features:
  - Morning stiffness (>30 min)
  - Pain at rest, relief with movement
  - Constitutional symptoms, including fever and weight loss
  - Skin and nail findings
- Must exclude MSK/neurologic emergency
  - Compartment syndrome and cauda equina are emergencies, while radiculopathy and neuropathy are not.
  - Neurologic causes of pain usually have a burning quality associated with numbness, paresthesia, constancy, worse at night, and unrelated to motion.
  - Discogenic/radicular: Back pain associated with pain/paresthesias in the legs (sciatica) and along the distribution of the compromised nerve. Pain is worse with positions that generate high intradiscal pressure (sitting, standing, bending forward), better in supine position.

!

LOW BACK PAIN

- Acute onset localized spine pain
- Pain waking patient up at night
- History of cancer
- Unexplained weight loss
- Immunosuppression (infection risk)
- Fever
- Trauma
- Bladder or bowel incontinence
- Urinary retention (with overflow incontinence)
- Saddle anesthesia
- Loss of anal sphincter tone
- Motor weakness in lower extremities
- Point vertebral tenderness

- Stenosis: Back pain and sciatica symptoms. Pain is worse with positions that minimize space within the spinal canal (standing erect), better leaning forward.
- Red flag symptoms must be discussed during a back pain history.

Physical Exam (Table 22.9)

TABLE 22.9 • **Physical exam of the back**

Gait and Posture	Examine for Structural or Functional Scoliosis
ROM	Pain on forward flexion suggests mechanical cause, while pain on extension suggests spinal stenosis
Palpation of spine and paraspinal muscles	Point tenderness over one vertebrae suggests infection or fracture
Heal-to-toe walking	A patient unable to heal-to-toe walk may have cauda equina syndrome 2° to multiple nerve root involvement
Straight leg raise	Pain between 30 and 60 degrees is suggestive of nerve root irritation; pain on crossed straight leg raise is suggestive of disk herniation
Neurologic testing	Weakness of dorsiflexion at first MTP and ankle suggests L4/L5 radiculopathy; sensory testing of medial (L4), dorsal (L5), and lateral (S1) areas of foot can be helpful in determining nerve root compression
Femoral stretch	Patient lies prone while hip is extended and knee flexed; flex knee and lift thigh off exam table—pain indicates lumbar nerve root irritation

Mechanical Causes

Focus on differentiating articular from nonarticular features. See sections on Inflammatory Arthritis and Mechanical Joint Pain. Tinel sign and Phalen test for carpal tunnel syndrome.

Neuropathic Causes

If presenting with back pain, the back exam is appropriate to differentiate radiculopathy from mechanical back pain.

Investigation and Diagnosis

- Blood work is *only* ordered to assist clinical judgment if infection and inflammatory arthritis flare are suspected.
- X-ray—often the first line of imaging to examine joint involvement. Neither sensitive nor specific.
- CT—indicated if referred pain from radiculopathy is suspected or fracture not visible on x-ray
- MRI—rarely indicated if only periarticular injury is suspected. Emergent MRI for suspected cauda equina.

Management

- Mechanical
  - Improve workstation positioning (ergonomics)
  - Avoid repetitive tasks
  - Evaluate psychosocial factors (worker—employer/worker interactions)
  - Physiotherapy
- Acute lumbosacral radiculopathy
  - Avoidance of activities that stress the spine (i.e., heavy lifting)
  - Bed rest should not last for more than 2 d.
  - Acetaminophen, NSAIDs, or muscle relaxants for pain
  - Heat or cold massage, acupuncture, support garments
  - Physiotherapy for accessory muscle strengthening
  - Proper posture, avoidance of standing or sitting in one position for long periods of time, sleeping on a firm mattress, and learning to lift properly can all reduce the rate of recurrence of low back pain.

        - Most episodes of acute mechanical low back pain resolve in 1 to 2 wk. Even with no treatment, 80% to 90% of episodes resolve within 6 wk.
- Other neuropathic pain
    - Identify/treat underlying cause
    - Pharmacotherapy: TCA, SNRI, anticonvulsant, long-acting opiate, topical lidocaine, capsaicin cream, intrathecal opioid or clonidine, botulinum toxin injection, nerve block
    - Surgical therapies: dorsal column neurostimulator, DBS (thalamus)
    - Other therapies:
        - Neuropsychiatry—CBT, psychotherapy
        - Rehabilitation—physiotherapy
        - Complementary and alternative medicine—acupuncture, meditation, massage therapy, traditional Chinese medicine

GENERALIZED PAIN SYNDROMES AND MYOPATHIES

MCC OBJECTIVES

Based on Objectives #50-3 (Non-Articular Musculoskeletal Pain) and #67-1-2-1 (Generalized Pain Disorders) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Chronic widespread pain syndromes are common and often difficult to diagnose and treat.
- Focus of this section will be common causes of diffuse, chronic MSK pain: FM and PMR.
- Generalized pain caused by inflammatory myopathies will also be discussed.

APPLIED SCIENTIFIC CONCEPT

- The diagnosis of FM is based on patient symptoms. There are no diagnostic laboratory tests or imaging. It is important to rule out other causes. The etiology/pathophysiology is unknown—hypotheses include the inability to obtain restful sleep and genetic abnormalities in epi-/norepinephrine or substance P.
- In patients >50, it is important to consider PMR as the cause of diffuse pain.
- PM and DM are idiopathic inflammatory myopathies associated with symmetric muscle weakness and muscle inflammation.

CAUSAL CONDITIONS

Differential for generalized pain disorders

Noninflammatory Causes

- FM
- Chronic fatigue syndromes

Systemic Inflammatory Arthropathies

- PMR
- RA
- SLE
- Ankylosing spondylitis

Inflammatory Myositis

- PM
- DM

Mental Health Disorders

- Depression
- Somatoform disorders

Endocrine

- Hypothyroidism

AppROACH

History/Physical Exam (Table 22.10)

TABLE 22.10 • History and physical exam for generalized pain syndromes and myopathies

	History	Physical
FM	• Affects women between the ages of 30 and 50 disproportionately (F:M = 10:1) • Overwhelming fatigue and cognitive dysfunction—"FM fog" • Gradual insidious onset of "total body pain" • Sleep disturbance • Aggravated by emotional stress • Other accompanying symptoms: irritable bowel, headaches, Raynaud phenomenon • History of trauma/depression/other MSK diseases	• Physical exam is essentially normal • New 2010 diagnostic criteria no longer require tender points for diagnosis, but rely on a pain index and SS score
PMR	• Usually age >50 • Usually acute/subacute onset of pain in neck, shoulders, pelvic girdle • Subjective weakness • Prolonged morning stiffness • Constitutional symptoms (fever, malaise, anorexia), aches, and pains in neck, shoulders, and pelvic girdle	• On MSK exam, normal muscle strength, decreased ROM of shoulders, neck, hips • Evidence of synovitis and bursitis • Check for signs of temporal arteritis
Temporal arteritis (also called GCA)	• PMR is often associated with temporal arteritis (15%–30% of patients) • Patients may present with headache, scalp pain, visual changes, jaw claudication	• Check temporal arteries for tenderness, pulsation, thickening • Check vision and visual fields
PM/DM	• Progressive muscle weakness • Difficulties with tasks requiring proximal muscles (e.g., getting up from a chair, climbing stairs) • Myalgias, polyarthralgias, fatigue • Swallowing difficulties	• Findings of symmetric proximal muscle weakness • Muscle atrophy • Skin manifestations are seen in DM and not in PM. ◦ V-sign, shawl sign, Holster sign, periungual erythema, Gottron papules, mechanic's hands, heliotrope rash

Investigations and Diagnosis

- **Fibromyalgia:**
  - There are no diagnostic laboratory tests; laboratory testing is used to rule out other causes of disease (CBC, ESR to exclude systemic inflammatory disease).
  - 1990 American College of Rheumatology diagnostic criteria for FM:
    - History of widespread pain (occurring on right and left sides of body, and above and below the waist)
    - Pain in 11/18 "tender points"
  - New 2010 diagnostic criteria for FM:
    - New criteria combine the scores of a WPI and a SS scale.
    - WPI measures the number of painful body regions over 1 wk, and the SS scale is a measure of fatigue, unrefreshing sleep, cognitive and somatic symptoms.
    - Must have history of >3 mo of symptoms, and no other disorder that would explain the symptoms
    - Does not require a tender point count
- **PMR:**
  - Diagnostic criteria:
    - Age >50
    - Bilateral aching and morning stiffness for at least 1 mo (in 2 out of 3 of the following areas: neck/torso, shoulders/proximal arms, or hips/proximal regions of thighs)
    - ESR >50

clinical box

Diagnosis of PMR requires ESR > 50 mm/h and exclusion of:

- Connective tissue disease
- RA
- Malignancy
- Infection

  - Anti-CCP, RF, and ANA usually negative
  - In patients with visual symptoms, jaw claudication and/or temporal artery tenderness suspect temporal arteritis
- Temporal arteritis:
  - If suspected, treat with corticosteroids and do temporal artery biopsy (do not wait for biopsy before treating)
    - May lead to blindness if not promptly treated
- **PM/DM:**
  - Symmetric proximal muscle weakness
  - Elevated muscle enzymes: CK, aldolase
  - Myopathic changes on EMG
  - Muscle biopsy abnormalities
    - PM: can show endomysial inflammatory infiltrates, muscle necrosis, atrophy
    - DM: perifascicular atrophy, perivascular/perimysial inflammation
  - Characteristic DM skin features (The main clinical feature that distinguishes DM from PM is cutaneous involvement.)
  - Additional tests:
    - Autoimmune serology: Anti-Jo-1, Anti-MI-2, Anti-SRP
    - CXR to detect pulmonary involvement (interstitial lung disease)
    - Skin biopsy (for DM)

Management

- **Fibromyalgia:**
  - Patient education
  - Sleep hygiene (regular hours, temperature regulation, limited noise, no stimulants)
  - Exercise (walking, yoga, swimming) has been shown to reduce pain and fatigue.
  - Pharmacologic: TCAs (amitriptyline), gabapentin/pregabalin (Note: NSAIDs and corticosteroids are not efficacious, and opioids should be avoided because of dependency risk.)
  - CBT, biofeedback therapy
- **PMR:**
  - 10 to 15 mg/d of prednisone until symptoms resolve, then slowly tapered over 1 to 2 yr (if no response within 72 h, consider alternate diagnosis)
  - Response to steroids is usually rapid.
  - Physiotherapy to maintain and restore ROM
- **Temporal arteritis:**
  - Temporal arteritis requires higher doses of prednisone than PMR (40–60 mg/d initially, then slow taper over 6–12 mo)
- **PM/DM:**
  - First line: corticosteroids
  - Second line: methotrexate, IVIG, azathioprine
  - Third line: cyclophosphamide, mycophenolate, cyclosporine, tacrolimus
  - Postdiagnosis follow-up:
    - Patients with DM have a high risk of developing malignancy and should have thorough physical exams, including breast, rectal, and pelvic exams.
    - They should undergo age-appropriate cancer screening such as colonoscopy and mammography.

clinical box

Adverse Effects of Corticosteroids

- Infection (check TB status)
- Osteoporosis
- Anxiety
- Hyperglycemia in diabetic patients
- Hypoadrenalism if withdrawn inappropriately

!

Giant cell arteritis can lead to blindness—treat promptly with glucocorticoids; if suspected, diagnostic biopsy can be conducted later.

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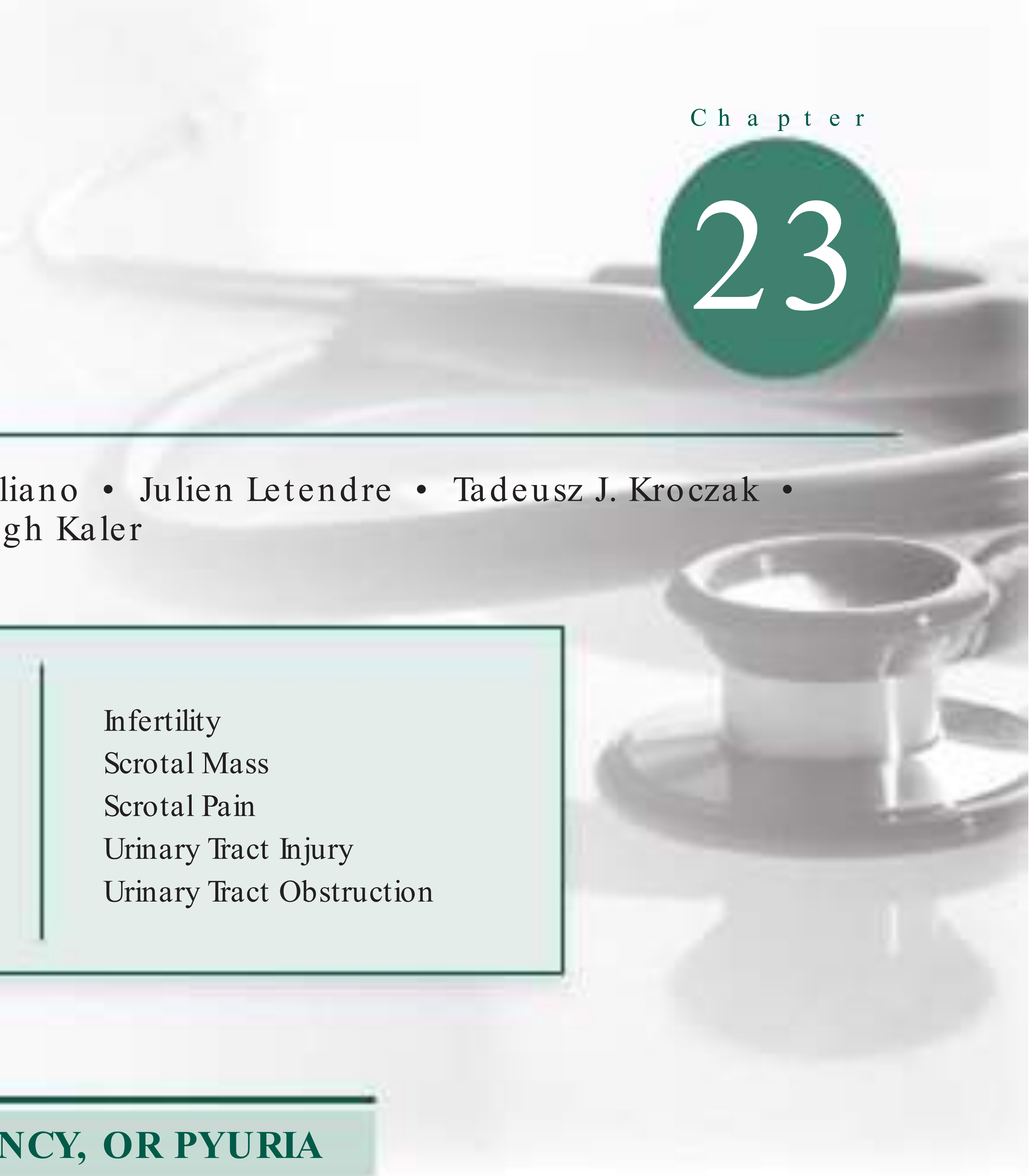

Chapter

23

Urology

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Urinary Tract Obstruction

DYSURIA, URINARY FREQUENCY AND URGENCY, OR PYURIA

MCC OBJECTIVE

Based on Objective #110-1 (Dysuria, Urinary Frequency and Urgency, and/or Pyuria) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

- Dysuria: pain or discomfort with micturition
- Urinary frequency: micturition at short intervals that is bothersome
- Urgency: sudden, compelling urge to urinate that is difficult to avoid
- Pyuria: men—presence of > 2 leukocytes/HPF; women—presence of > 5 leukocytes/HPF

APPLIED SCIENTIFIC CONCEPT

Cystitis describes a common clinical syndrome of dysuria and urinary frequency and urgency, which is sometimes associated with suprapubic pain and often found in the presence of pyuria. These symptoms, although generally indicative of bacterial cystitis, may also be associated with other infections of the urethra or vagina. See Table 23.1 for classification of UTI.

CLINICAL box

Significance of UTI in Different Groups

Gender	Females	Often normal in healthy females (short urethra and its perineal positioning) Often coincides with sexual activity (premenopausal)
	Males	Generally an underlying problem (stasis from obstruction, stones, etc.)—the long male urethra and the bactericidal properties of the prostate secretions generally protect against bacterial invasion
Age	Children	Uncircumcised males (< 1 y.o.) Consider obstruction (ureteropelvic obstruction) Vesicoureteral reflux
	Elderly	Stasis from obstruction (benign prostatic hyperplasia) Manipulation of urinary tract (catheterization)

TABLE 23.1 • Classification of UTI

Classification	Categories	Explanation	
Anatomic	Upper	Pyelonephritis, ureteritis	
	Lower	Cystitis Prostatitis Orchiepididymitis, Epididymo-orchitis	
Clinical	Uncomplicated	Patients with structurally normal urinary tract who respond to short course of antibiotics. Mostly females.	
	Complicated	Abnormal genitourinary tract Male Pregnant Children Elderly Diabetes mellitus Immunocompromised Urolithiasis Recent instrumentation Nosocomial	
Clinical/ chronologic classification	Isolated (sporadic)	First infection or remotely occurring infection Most common type	
	Unresolved bacteriuria	Urine not sterilized after antibiotic treatment	**Causes** Bacterial resistance (inadequate antibiotic therapy) Azotemia (poor antibiotic excretion) Patient noncompliance Rapid reinfection (another infection) Papillary necrosis Infected calculi, tumour, foreign object
	Recurrent	Repeated infection (after treatment) interrupted by periods of sterile urine Usually signals the presence of a predisposing condition	**Relapse** Within 2 wk of treatment Same bacteria **Reinfection** > 2 wk after treatment

CLINICAL box

Risk Factors for UTI

Age (yr)	Sex	Major Risk Factor
< 5	Male and female	Anatomic anomalies (UPJ, VUR)
	Male	Uncircumcised
6–15	Male and female	Functional anomalies (dysfunction voiding)
16–35	Female	Sexual intercourse, spermicidal use
36+	Female	Gynecologic surgery, genital prolapse
	Male	Obstruction
50+	Female	Postmenopausal

CAUSAL CONDITIONS (FIGURE 23.1)

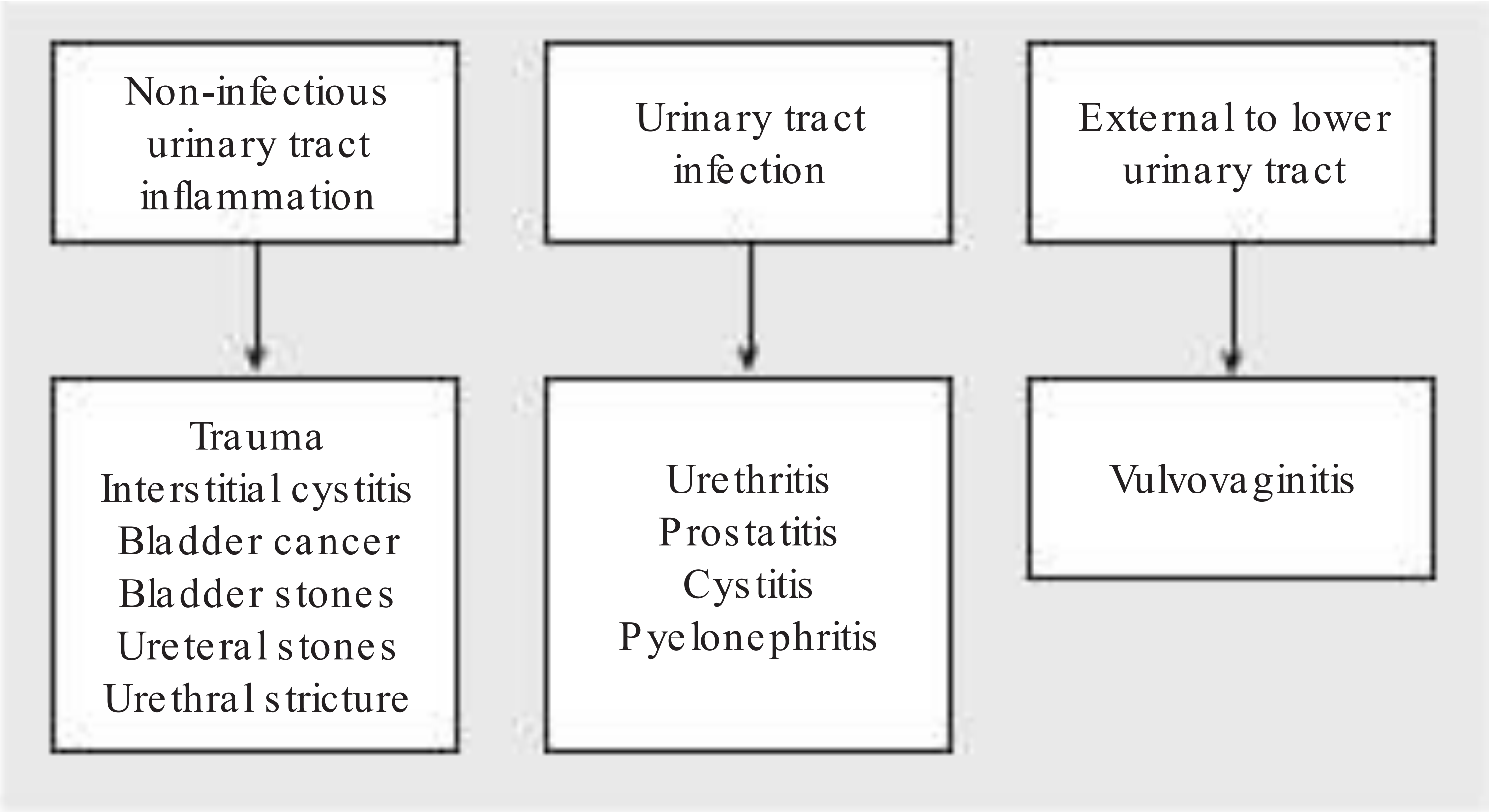


Figure 23.1. Causal conditions of UTI.

APPROACH

History

Initial investigation is intended to screen for UTIs and eliminate underlying pathology. History should include characterizing baseline urinary function. Smoking history, frequency of UTIs, and risk factors according to gender and age must also be delineated.

See Table 23.2 for the differences between cystitis and pyelonephritis, and Table 23.3 for the differentiation of acute pain at micturition in women

TABLE 23.2 • Cystitis versus pyelonephritis

Finding	Cystitis	Pyelonephritis
Dysuria	+	±
Fever	−	+
Chills	−	+
Pyuria	+	+
Bacteruria	+	+
Hematuria (micro + macro)	+	+
Bacteremia	−	+
Costovertebral tenderness	−	+
Complication	Evolution to pyelonephritis Relapse of infection Bacterial persistence	Bacteremia and septic shock Renal parenchymal damage (pyonephrosis, emphysematous pyelonephritis, renal abscess) Papillary necrosis
Predisposing factors	Female Obstruction Indwelling catheter Sexual intercourse Urolithiasis Foreign bodies	VUR Nephrolithiasis Cystitis UPJ

+ , finding present; −, findings absent; ±, may or may not be present.

TABLE 23.3 • Differentiation of acute pain at micturition in women

	Bacterial Cystitis	STI	Vaginitis
Onset	Acute	Acute	Gradual
Associated symptoms	Nonspecific	Nonspecific	Nonspecific
Exam	± Suprapubic tenderness	Vaginal discharge (leucorrhea)	Pruritus
Urinalysis	Pyuria > 90% Hematuria in 50%	Pyuria (occasionally) No hematuria	No pyuria
Definitive diagnosis	Urine culture	Physical exam points to PID and Gram stain, culture or PCR of cervical and urethral samples	Gram stain and culture of discharge

Adapted with permission from Siroky MB, Oates RD, Babayan RK. Handbook of Urology. 3rd ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2004.

Physical Exam

- Urethral discharge—urethritis
- Painful prostate exam—prostatitis
- Suprapubic tenderness—cystitis
- Costovertebral tenderness, fevers, chills—pyelonephritis

Investigation

Urine culture should be performed in the following situations: suspected upper and lower tract UTI, male UTI, febrile UTI, complicated UTI.

In children, an abdominal US can be performed to look for signs of obstruction (dilation of the collection system—hydroureter, hydronephrosis—and thickening of vesical wall); a VCUG can be used to detect VUR; a 99mTc-DMSA scan be used to identify acute pyelonephritis or renal scarring and to evaluate the function of each kidney separately.

Indications for additional investigation for UTIs can be found in Table 23.4.

TABLE 23.4 • Indications for additional investigations and/or referral for UTIs

Male	All ♂ patients
Female	Recurrent or persistent UTI Girls < 5 y.o.
Male and female	Persistent fever after adequate treatment Evidence of obstruction (emergency) Gross hematuria History of calculi

CLINICAL box

Sample Collection for Analysis

Men	Midstream clean catch (provides uncontaminated samples most of the time)
Women	Midstream clean catch: • If normal urinalysis, no further tests needed • If contaminated: catheterization specimen • Catheterization causes UTI in 1% of ambulatory and 10% of inpatients.
Children	Plastic bag covering cleansed meatus (frequent contamination) Catheterization: • Should not be performed regularly in boys • Suprapubic aspiration in infants (most reliable method and rarely contaminated)

Diagnosis

A diagnosis of a UTI cannot be made without a positive urine culture. Initial evaluation of patients presenting with symptoms related to UTI includes a dipstick urinalysis.

- Nitrites—sensitivity 45%–60%, specificity 85%–98%
- Leukocyte-esterase—48%–86%, specificity 17%–93%
- Combined positive test sensitivity is 68%–88%

CLINICAL box

Pathogens Responsible for UTIs

Bacteria	Percentage (%)
E coli	60
Klebsiella spp.	14.8
Proteus mirabilis	7
S aureus	8.5
Pseudomonas aeruginosa	3.4

Management

Urinary Tract Infections

Empiric antibiotic therapy should be started (and adjusted for culture and sensitivities if available; see Table 23.5).

TABLE 23.5 • Empiric antibiotic therapy for UTIS

	Type of Infection		Antibiotics	PO vs. IV	Length of Treatment
Uncomplicated	Acute cystitis	First line	TMP-SMX	PO	3 d
		If allergy or high incidence of resistance	Ciprofloxacin		
	Acute pyelonephritis	Mild	Ciprofloxacin	PO	7–14 d
		Severe	Ciprofloxacin + third-generation cephalosporin	IV	
	If gram positive on Gram stain	Assume enterococci	Amoxicillin ± clavulanate	PO	
		If severe	Amoxicillin + clavulanate + gentamicin	IV	
Complicated	Cystitis or pyelonephritis	Generally more resistance organisms	Third-generation cephalosporin or ciprofloxacin	IV	
	If gram positive or Gram stain	Assume enterococci	Ampicillin + gentamicin		

Asymptomatic Bacteruria—Indications for Antibiotic Therapy

- Pregnant
- Undergoing urologic procedure
- GU tract obstruction
- Children with vesicoureteral reflux
- *Proteus* and *Pseudomonas* species

Indications for Hospital Admission in Pyelonephritis

- Infection + obstruction
- Hemodynamics/instability (septic shock)
- Inability to maintain hydration or intolerable to oral medication
- Severe pain or debilitation
- Failure of outpatient therapy and/or severe nausea/vomitting
- Lack of follow-up or compliance
- Diagnostic uncertainty

ERECTILE DYSFUNCTION

MCC OBJECTIVE

Based on Objective #48 (Erectile Dysfunction) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

According to the Canadian Urological Association Guides on erectile dysfunction, ED is defined as the "…persistent or recurrent inability to achieve and maintain a penile erection of sufficient rigidity to permit satisfactory sexual activity for at least 3 months". Approximately 80% of ED has a primary organic cause (e.g., atherosclerosis). ED is present when an erection of sufficient rigidity for sexual intercourse cannot be acquired or sustained more than 75% of the time. ED can cause significant psychosocial difficulties for patients and can have a major impact on relationships. According to the *Massachusetts Male Aging Study*, the prevalence of ED is < 10% for men < 40 y.o., 10%–30% for men 40–60 y.o., 20%–40% for men 60–70 y.o., and 40%–70% for men > 70 y.o.

APPLIED SCIENTIFIC CONCEPTS (FIGURE 23.2)

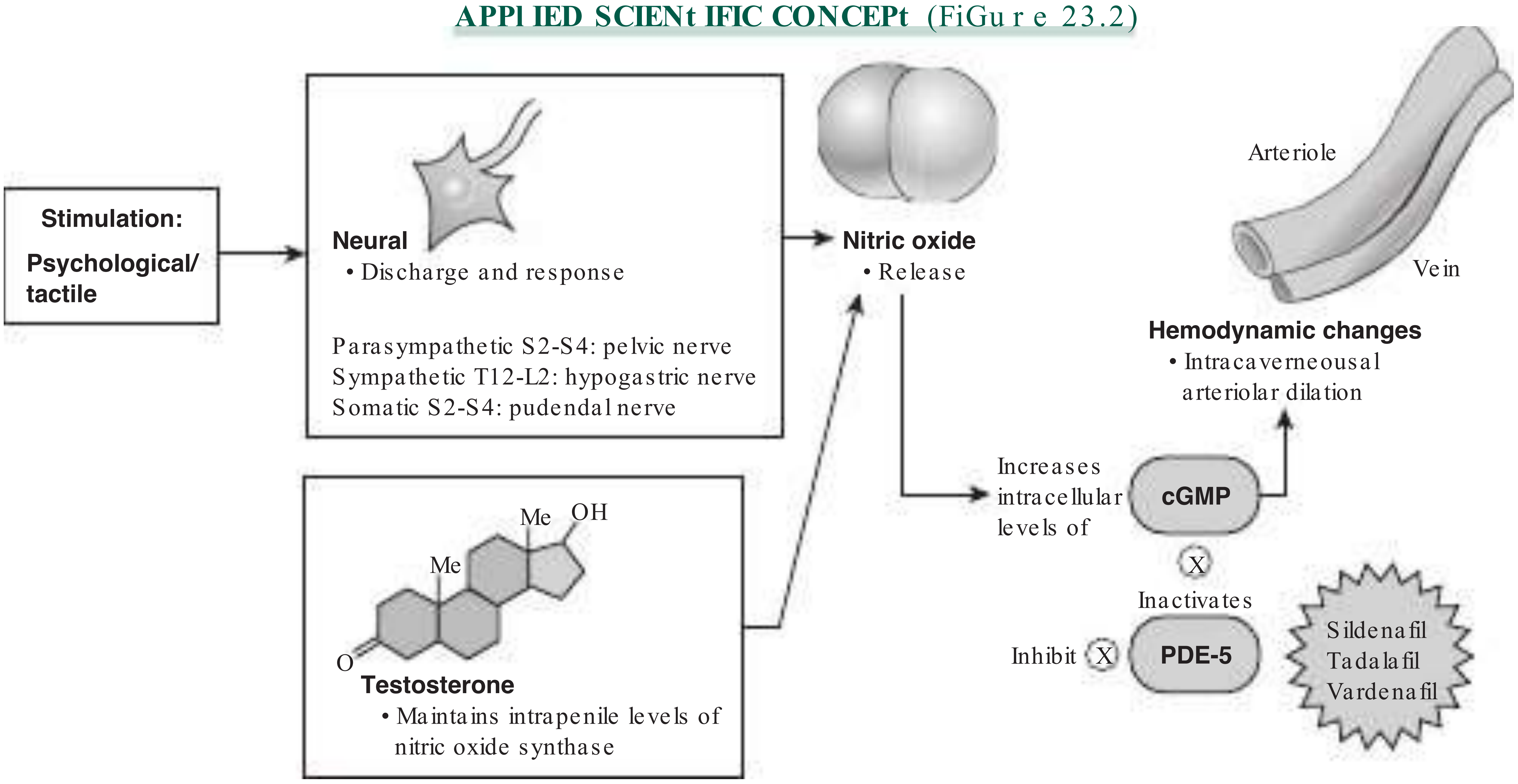

Stimulation:
Psychological/tactile
Neural
• Discharge and response
Parasympathetic S2-S4: pelvic nerve
Sympathetic T12-L2: hypogastric nerve
Somatic S2-S4: pudendal nerve
Nitric oxide
• Release
Arteriole
Vein
Hemodynamic changes
• Intracaverneousal arteriolar dilation
Increases intracellular levels of
cGMP
X
Inactivates
Inhibit
X
PDE-5
Sildenafil
Tadalafil
Vardenafil
Me
OH
Me
O
Testosterone
• Maintains intrapenile levels of nitric oxide synthase

Figure 23.2. Physiology of erection and site of action of major drugs.

CAUSAL CONDITIONS (see Clinical Box)

CLINICAL box

Mnemonic of Causal Conditions of ED: IMPOTENCE

- Inflammatory: prostatitis, urethritis, stricture
- Mechanical: chordee, Peyronie disease, phimosis
- Occlusive: arteriogenic
- Traumatic: pelvic fracture, urethral rupture
- Endurance: cardiovascular disease
- Neurologic: neuropathy, temporal lobe epilepsy, multiple sclerosis
- Chemical: alcohol, marijuana, prescription drugs (e.g., SSRIs, β-blockers, thiazides, hormone modulators, 5α-reductase inhibitors)
- Endocrine: testicular failure, pituitary failure, hyperprolactinemia; diabetes mellitus

APPROACH

History

- Consider potential psychogenic components for ED, which accounts for approximately 10% of cases.
- When ruling out psychogenic ED, it is important to determine the incidence of involuntary erections (i.e., morning erections), performance with manual stimulation (i.e., masturbation), and any perceived acute situational ED or associated performance anxiety.
- It is important to screen for cardiovascular and neuropathic risk factors such as smoking, dyslipidemia, diabetes, hypertension, obesity, and alcoholism.
- Rarer causes of ED must be considered on the differential diagnosis, including trauma, and hyperprolactinemia.
- It is important to discuss goals and expectations with the patient.

Physical Exam

- Blood pressure
- Thorough neurologic exam including bulbocavernous reflex
- Genitourinary exam—anatomical survey and testicular exam for hypogonadism

Investigations

- CBC, urinalysis, serum prolactin, FSH, LH, TSH
- Testosterone (if low libido, abnormal physical exam—draw between 9 and 7–11 am)
- Fasting glucose, HBA_{1c}, lipid profile

Management

A significant portion of patients presenting with ED can be diagnosed with history alone.

- Lifestyle/psychosocial
- Addressing any psychological components is an important first step, which includes counseling and education. Lifestyle modifications, depending on the suspected cause of ED, should also be encouraged.
- Pharmacologic therapy
  - PDE-5 inhibitors: sildenafil, tadalafil, vardenafil (first line therapy)
  - Intracavernous injections: smooth muscle relaxants and vasodilators
  - MUSE intraurethral suppository
  - Androgen replacement (**NB:** only indicated in patients with documented androgen deficiency)
- Vacuum devices
- Surgical intervention
  - Penile prosthesis (inflatable or semirigid)

NB: PDE-5 inhibitors are some of the most commonly used prescription medications for ED. However, there are several important contraindications to be aware of:

Absolute contraindications: nitrate use (e.g., nitroglycerine) or allergy to medication

Relative contraindications: baseline hypotension, liver or renal insufficiency, use of pharmacologic agents that inhibit cytochrome P450 (e.g., olanzapine), CHF NYHA ≥ 2, MI/stroke in last 6 months

HEMATURIA

MCC OBJECTIVE

Based on Objective #8 (Blood in Urine/Hematuria) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Hematuria presents as either gross (visible) or microscopic (≥ 3 RBC/HPF on two UA). It is a common clinical finding, which may arise from benign or malignant etiologies. Proper management of these patients is required for accurate diagnosis.

APPLIED SCIENTIFIC CONCEPT

- Glomerular capillaries filter blood molecules based on size and electrical charge.
- The basement membrane's negatively charged proteoglycans repel molecules with negative electrical charge (e.g., albumin).

- Activation of the humoral and cellular immunity pathways, and complement system, alters those properties allowing albumin and RBCs to be filtered and reach Bowman capsule, resulting in proteinuria and hematuria.

CLINICAL box

Causes of Non-RBC Red Urine

HEME +

Hemoglobinuria
- Dialysis
- Hemolysis

Myoglobinuria
- Rhabdomyolysis
- Rifampin
- Trauma

HEME −

Drugs
- Sulfa drugs
- Nitrofurantoin
- Salicylates
- Phenytoin

Foods
- Beets
- Food coloring

Metabolites

CLINICAL box

Most Frequent Etiologies by Age and Sex

Age 0–20	Glomerulonephritis, UTI, congenital anomalies
Age 20–40	UTI, calculi
Age 40–60	Female: UTI > calculi > bladder tumor Male: bladder tumor > calculi, UTI
Age > 60	Female: bladder tumor > UTI Male: BPH > bladder tumor > UTI

CAUSAL CONDITIONS (TABLE 23.6)

TABLE 23.6 • Causal conditions of hematuria

Renal	Transient • Inflammation (e.g., pyelonephritis), stones • Exercise induced • Trauma Tumor • RCC, TCC, Wilms tumor Tubulointerstitial • Polycystitic kidney disease Vascular • Papillary necrosis • Sickle cell disease • Arteriovenous malformation • Thromboembolism (e.g., renal artery embolism, renal vein thrombosis)
Glomerular	Isolated (e.g., Alport syndrome, IgA nephropathy) Postinfections (e.g., postinfectious gram-negative) Systemic involvement (e.g., SLE, erythematosus, vasculitis)
Ureteral	Ureteral polyps Ureteral cancer
Bladder	Bladder polyps Bladder cancer Inflammation (e.g., cystitis, stones)
Prostate	BPH Late stage prostate cancer Prostatitis
Urethra	UTI STI Stricture

APPROACH

History

Hematuria can be asymptomatic or symptomatic. Identifying the frequency and any associated symptoms can aid in identifying the etiology. History should also focus on risk factors for bladder cancer as outlined below. Furthermore, the timing of hematuria during micturition may indicate the site of bleeding. Hematuria on initial stream suggests a urethral lesion. Terminal hematuria suggests bleeding from the prostate, bladder neck or trigone. Hematuria throughout the stream suggests a bladder or upper tract etiology.

Establish hemodynamic stability first when evaluating gross hematuria

Bladder Cancer Risk Factors

- Cyclophosphamide
- Occupational exposure to chemicals (benzenes or aromatic amines)
- Blackfoot disease
- Radiation to pelvis
- A. fangchi
- Smoking
- Chronic UTI
- Analgesia abuse
- Renal transplant recipients
- Schistosomiasis haematobium

Patients with any of the aforementioned risk factors are considered high risk for malignancy.

Physical Exam

Exam of those presenting with hematuria is fairly general. Patients presenting with gross hematuria must have their vital signs evaluated for signs of hemodynamic instability. Serum hemoglobin may also be indicated depending on the extent of blood loss derived from the patient history, or if the patient's vital signs demonstrate hemodynamic instability. Further exam should include costovertebral tenderness for signs of pyelonephritis. The classic triad for renal cell carcinoma includes flank pain, palpable flank mass, and hematuria. However, this triad is practically rarely observed. In addition, a complete genitourinary exam should be performed, including penile, scrotal, and digital rectal exam.

Investigations/Diagnosis

Workup: Microscopic Hematuria

- High risk or over 40 yr: history and physical exam, urinalysis, urine culture, urine cytology, upper tract imaging (US of kidneys and bladder), and cystoscopy for lower tract evaluation
- Low risk: if history suggests a benign cause, repeat should be performed in the absence of vigorous physical activity, sexual activity, or menstruation. If repeat urinalysis is positive, low-risk patients undergo the same evaluation as high-risk patients excluding cystoscopy.

Patients with recent exercise, menses, sexual activity, urethral trauma, or instrumentation may have incidental microscopic hematuria on urinalysis. In these cases, repeat urinalysis is indicated. If negative, no further workup is necessary.

Workup: Asymptomatic Gross Hematuria

All patients should have a history and physical exam, urine cytology, urinalysis, upper tract imaging (CT-IVP), and cystoscopy.

Management

Indication for Nephrology Referral

- Presence of proteinuria, red cell casts, or dysmorphic red blood cells on microscopic exam and/or an elevated creatinine is suggestive of a glomerular cause of hematuria (Grade C recommendation; Level 3b and 4 evidence).

Follow-Up

- Patients should be followed up by their primary care physicians for a urinalysis, urine cytology, and blood pressure checks at 6, 12, 24, and 36 mo (Grade C recommendation; Level 3b and 4 evidence).
  - Repeat urologic workup is required if the patient develops recurrent gross hematuria, positive or atypical cytology, or irritative voiding symptoms with infection.

Incontinence—Adult

MCC ObjECt Iv E

Based on Objective #47-2 (Incontinence, Urine, Adult) of *Objectives for the Qualifying Examination*, 3rd edition.

Ov ERv IEw

Urinary incontinence is an involuntary loss of urine and may lead to significant psychosocial impairment. Occasionally, it can be associated with significant pathology.

APPLIED SCIENTIFIC CONCEPTS AND CAUSAL CONDITIONS (Table 23.7)

TABLE 23.7 • Classification, pathophysiology, and causal conditions of urinary incontinence

Classification			
	Clinical	Mechanism	Pathophysiology and Associated Causes
Transient	Polyuria		
	Inability	Impaired ability and/or willingness to reach toilet	
	Drugs, alcohol		Diuretic effect, inability to concentrate urine, etc.
Neurologic	Cauda equina	Caused by intervertebral disk herniation	Direct compression of sacral nerve roots
Anatomic	Urgency	Overactive bladder (detrusor contraction overcomes sphincter inhibition)	• Irritation of bladder mucosa ◦ Infection, stones, cancer, foreign objects • Neurogenic ◦ MS, Parkinson disease, etc. ◦ Diabetes mellitus • Other ◦ Iatrogenic ◦ Idiopathic (bladder instability): by definition, not related to neurologic defect
	Stress	Insufficient outlet pressure	• Lack of support from pelvic floor ◦ Multiple vaginal deliveries ◦ Postmenopausal (decreased estrogen) • Iatrogenic ◦ Gynecologic procedures ◦ Radical prostatectomy ◦ Pelvic radiation
	Overflow	Bladder underactive (detrusor atony)	• Neurologic lesion (trauma or other) ◦ Sacral region of spine (S2–S5) ◦ Peripheral nerves (pudendal or pelvic nerve) • Congenital defect ◦ Spina bifida
		Outlet obstruction (mechanical hindrance to flow)	• Extrinsic obstruction ◦ BPH ◦ Advanced prostate cancer • Intrinsic obstruction ◦ Urethral stricture ○ Transurethral surgery ○ Postinfectious (STI) • Congenital ◦ Posterior urethral valves (boys)

CLINICAL box

Neurogenic bladder
Consider:
- MS
- Spinal trauma (including iatrogenic)
- Stroke
- Diabetes mellitus

Transient causes of incontinence (in elderly):
DIAPPERS
- Delirium
- Infection
- Atrophic urethritis or vaginitis
- Pharmaceuticals
- Psychogenic
- Excessive urine output
- Restricted mobility
- Stool impaction

APPROACh

History

A comprehensive history is required for all patients presenting with urinary incontinence.

Determining the Duration of Symptoms

- When does it occur? With coughing, sneezing? When experiencing urgency?
- How often does it occur?
- If the patient wears pads, how many?

Associative Symptoms

- Dysuria, fevers, chills, and night sweats
- Hematuria
- Symptomatic pelvic organ prolapse in women

History

- Obstetrical history
- Previous anti-incontinence surgeries
- Previous pelvic radiation therapy

Fluid Intake

- Alcohol
- Tea/coffee

CLINICAL box

Stress vs. Urgency Incontinence

	Stress Incontinence	Urge Incontinence
Definition	Involuntary loss of urine with efforts that cause increased intra-abdominal pressure (coughing, sneezing, laughing, lifting)	Involuntary urine leakage accompanied by the need to urinate
Pathophysiology	An increased abdominal pressure is transmitted to the bladder, which, due to reduced pelvic support, allows leakage of urine	Uninhibited bladder contractions that cause an increased intravesical pressure, which, when higher than urethral resistance, causes leakage

Physical Exam

General Status

- Mental status
- Obesity
- Physical dexterity
- Mobility

Abdominal

- Signs of bladder overdistension—suprapubic mass with tenderness on palpation. BladderScan if concerned regarding elevated postvoid residual volumes.

Digital Rectal Exam

- Anal sphincter tone
- Size, consistency, and symmetry of prostate

Pelvic

- Speculum: Look for fistula, prolapse, vaginal mucosal atrophy. During the pelvic exam, can ask patient to cough (increase intra-abdominal pressure); if there is leakage of urine, can diagnose stress incontinence. Urethral mobility can also be assessed.

Neurologic

- Rule out serious CNS disease (MS) or peripheral nerve disease (diabetes mellitus, trauma)
- Bulbocavernous reflex (if absent, signals pathology between S2 and S4. Absent in 2% of men and 30% of women)

Investigations

- Urinalysis and culture and sensitivity to assess for urinary tract infection. 3-d voiding diary and quality of life questionnaire.
- Uroflowmetry and postvoid residual assessment for patients with symptoms suggestive of BPH
- Cystourethroscopy is warranted in patients with concurrent lower urinary tract symptoms and hematuria.
- Urodynamic study is indicated when the diagnosis remains uncertain after history and physical exam, if a patient fails medical treatment or if the history suggests incontinence with a mixed etiology.

Diagnosis

Urinalysis is critical in determining if a UTI may be causing the patient's lower urinary symptoms. A positive urine culture is required for a diagnosis of a UTI.

Diagnosis of stress and urgency incontinence is largely based on history.

Urge Incontinence

- Urgency, frequency, nocturia without concurrent UTI

Stress Incontinence

- History of multiple pregnancies
- Postmenopausal
- Loss of urine with sneezing, cough, jumping, etc.

Incontinence can often be elucidated in clinic; however, in cases of clinical ambiguity or patients who do not respond to treatment, should be referred for urodynamics.

Management

- Patients with a positive urinalysis require treatment for their UTI—please refer to management of UTI under dysuria, urinary frequency and urgency, and/or pyuria.
- **Lifestyle modifications**—reducing fluid intake, limiting coffee and alcohol intake, timed voiding.
- **Urge incontinence—**anticholinergics, lifestyle modifications.
- **Stress incontinence—**Kegel exercises, pelvic floor physiotherapy, devices such as pessaries and endovaginal cones. Surgical procedures such as urethral slings or artificial urinary sphincters.

INCONTINENCE—CHILD

MCC OBJECTIVE

Based on Objective #47-3 (Incontinence, Urine, Pediatric/Enuresis) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

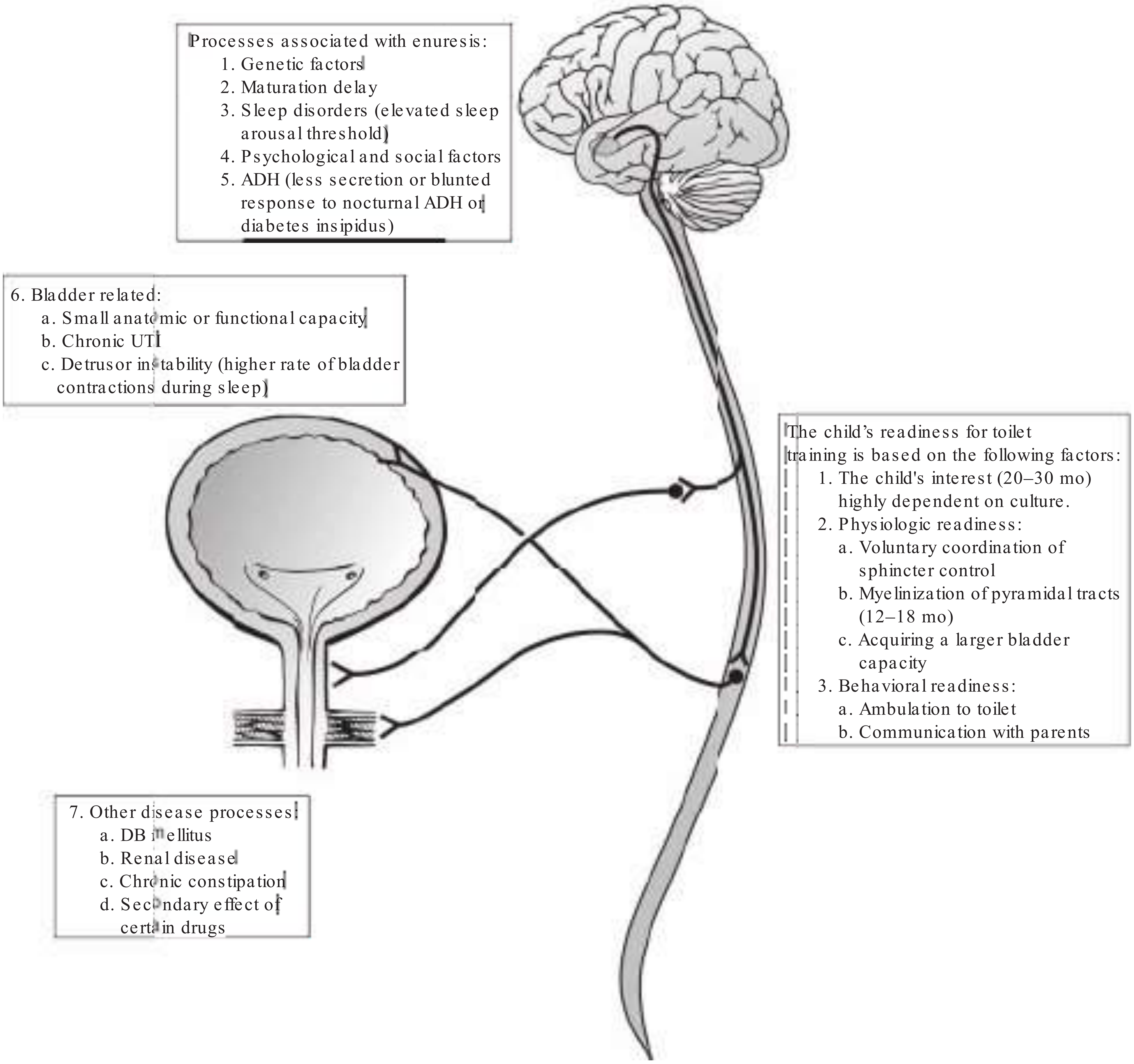
Enuresis is the repeated voiding of urine into a child's clothes or bed after the developmental (not necessarily chronological) age of 5 yr. It must either occur twice a week during a 3-mo period or it must cause significant distress and impairment (according to the *DSM V* criteria). Although most children with enuresis will have no apparent organic cause, screening is necessary to rule out neurologic or anatomic disease or development deficits.

APPLIED SCIENTIFIC CONCEPT

Classification of Enuresis

- Diurnal or nocturnal
- Primary (never been consistently dry at night) or secondary (resumes wetting after 6 mo of continence/dryness)

See Figure 23.3 for processes associated with enuresis and normal toilet training



Processes associated with enuresis:
1. Genetic factors
2. Maturation delay
3. Sleep disorders (elevated sleep arousal threshold)
4. Psychological and social factors
5. ADH (less secretion or blunted response to nocturnal ADH or diabetes insipidus)

6. Bladder related:
   a. Small anatomic or functional capacity
   b. Chronic UTI
   c. Detrusor instability (higher rate of bladder contractions during sleep)

7. Other disease processes:
   a. DB mellitus
   b. Renal disease
   c. Chronic constipation
   d. Secondary effect of certain drugs

The child's readiness for toilet training is based on the following factors:
1. The child's interest (20–30 mo) highly dependent on culture.
2. Physiologic readiness:
   a. Voluntary coordination of sphincter control
   b. Myelinization of pyramidal tracts (12–18 mo)
   c. Acquiring a larger bladder capacity
3. Behavioral readiness:
   a. Ambulation to toilet
   b. Communication with parents

Figure 23.3. For processes associated with enuresis and normal toilet training.

Causal Conditions (Table 23.8)

table 23.8 • Causal conditions of enuresis

Classification	Common Causes
Primary nocturnal	Idiopathic Familial Bladder dyssynergia
Secondary nocturnal	Psychogenic/stress
Diurnal + nocturnal	Urinary tract infection Diabetes mellitus, diabetes insipidus Anatomic abnormality Neurologic disorder Developmental conditions Bladder dysfunction

APPROACH

History

- Family history of enuresis
- Stressful conditions and contributory psychosocial factors (moving of the family, divorce/death in the family, birth of a sibling, etc.)
- Details of fluid intake and bowel habits
- Known medical conditions
  - Neurologic
  - Urinary
  - GI
- Urinary signs and symptoms
  - Hesitancy
  - Dribbling
  - Painful micturition

Physical Exam

- Abdominal and genital exam
- Rectal exam if the child has chronic constipation
- Spine (lumbosacral) to rule out spina bifida/tethered cord

Investigations

- Urinalysis, to screen for:
  - UTIs
  - Renal disease
  - Diabetes mellitus
- Voiding diary (document times, volumes, and episodes of incontinence)
- Renal US in older children or children who do not respond to treatment

Management

Educate parents about the potential psychological side effects that may have on their child. Treat underlying conditions. Treatment of chronic constipation may be the only solution required. There are three basic treatment approaches:

- Conditioning therapy (good success rate; low relapse)
  - Enuresis alarms (a device which senses urine in the child's underwear)
  - Conditioned awakening and timed voiding at specific hours of the day
- Reward system: bladder stretching by having the child progressively refrain from urinating for increasing periods of time coupled with a reward
- Pharmacotherapy: good short-term success rate; high relapse
  - DDAVP
  - Oxybutynin

INFERTILITY

MCC OBJECTIVE

Based on Objective #46 (Infertility) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Infertility is defined as the inability to conceive after 1 yr of intercourse without contraception. It affects approximately 15% of couples. Both partners must be investigated: A male factor is solely responsible for approximately 20% of infertility problems, whereas male and female factors are involved in 30% to 40%.

APPLIED SCIENTIFIC CONCEPT (Figure 23.4)

- Testis is located outside the body because spermatogenesis occurs at lower temperatures than the core temperature. Pathologies or habits that increase scrotal temperature affect spermatogenesis.
  - Varicocele consists of dilated veins of the pampiniform complex, allowing an increase in temperature of the scrotal content and reflux of toxins from the body, resulting in poorer spermatogenesis.

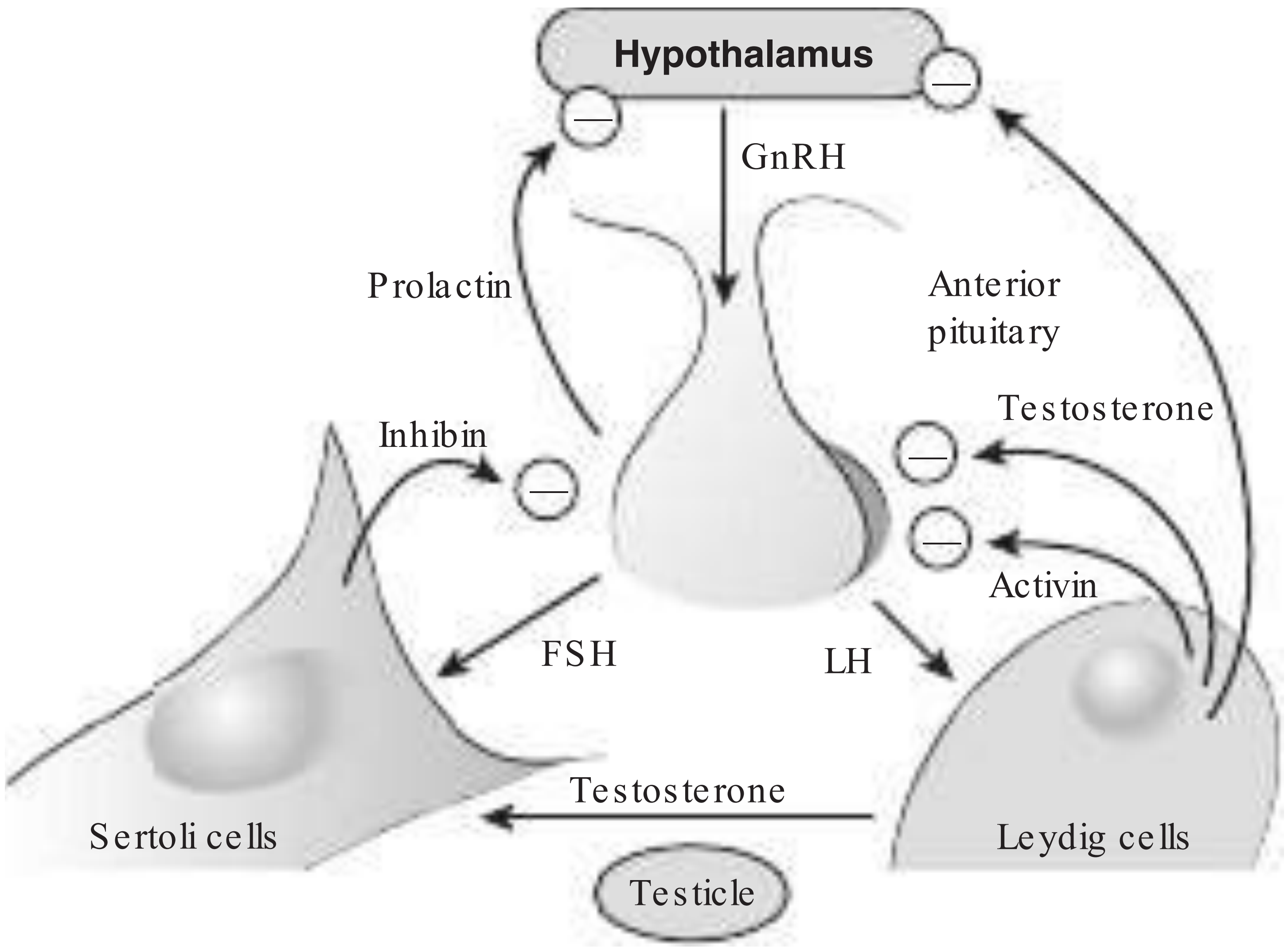


Figure 23.4. Spermatogenesis.

CAUSAL CONDITIONS (Table 23.9)

TABLE 23.9 • Differential diagnosis of male infertility

Pretesticular	Hypothalamic disease	Gonadotropin deficiency (Kallmann syndrome) Congenital hypogonadotropic syndromes
	Pituitary disease	Pituitary insufficiency Hyperprolactinemia Endogenous/exogenous hormones
Testicular		Chromosomal (e.g., Klinefelter syndrome [XXY], microdeletion) Cryptorchidism Testicular trauma Viral orchitis Varicocele Radiation Drugs (e.g., ROH, lithium, α-blockers, TCAs, CCB, steroids) Idiopathic
Posttesticular	Obstruction	Congenital bilateral absence of the vas deferens (associated with CF) Acquired (e.g., vasectomy/groin surgery/infection) Functional (e.g., nerve injury/drugs)
	Sperm motility or function	Immotile cilia Maturation defects Immunologic infertility Infection
	Disorders of coitus	Impotence Hypospadias Timing and frequency

APPROACH

History

- Infertility history: duration, prior conceptions, previous fertility evaluation, and treatment

- Sexual history: erectile function, lubricants, timing/frequency of intercourse
- Childhood: cryptorchidism, onset of puberty, testicular pathology, torsion, trauma
- Medical: diabetes, cancer—chemotherapy/radiation
- Infection: UTIs, STIs, orchitis, epididymitis, mumps
- Surgical: orchiopexy, vasectomy, bladder neck/prostate surgery
- Family history: cystic fibrosis, infertility
- For partner: age, previous conceptions, gynecologic history, medical history

Physical Exam

- Genital
  - Testis, firm (normal), soft (abnormal)
  - Normal size > 4 cm
  - Varicocele
  - Palpate vas deferens
  - Hypospadias

Investigations

- Semen analysis × 2 (Table 23.10)

TABLE 23.10 • Semen analysis (WHO criteria)

Characteristics	Reference Values
Ejaculate volume	> 1.5 mL
pH	> 7.2
Sperm concentration	> 15 × 10^6/mL
Total sperm count	> 39 × 10^6/ejaculate
Motility	> 32% progressive motility
Morphology	> 4% normal (strict criteria)
White blood cells	< 1 × 10^6/mL

- Other investigations may be indicated pending semen analysis results, including:
  - Karyotype
  - FSH, LH
  - Testosterone
  - Scrotal/prostatic US

Management

- Recommend for acid folic intake preconception
- Counsel on proper sexual habits
- Timing with ovulation (intercourse every 2 d starting 2 d before ovulation for 5 d)
- No lubricants
- Referral to a urologist if an anomaly is present on two sperm analysis
  - Oligospermia (small number of spermatozoids)
  - Low volume of ejaculate
    - Rule out improper collection and retrograde ejaculation
  - Low mobility
  - Teratospermia (structural defects of spermatozoids)
  - Combination (e.g., oligoteratospermia—OAT)
    - OAT is the most common anomaly associated with varicocele.
      - Correction of varicocele should be attempted since it has been associated with an increased probability of pregnancy.
- If evaluation of both partners is normal, couple should be referred to an infertility specialist for more advanced investigation.
- Investigation for infertility may reveal serious health issues.
  - Testicular cancer
  - Patients with severe oligospermia may have genetic abnormalities and should be referred appropriately.
- Options if fertility is not correctable:
  - Intrauterine insemination
  - *In vitro* fertilization ± intracytoplasmic sperm injection
  - Surrogacy
  - Adoption

SCROTAL MASS

MCC OBJECTIVE

Based on Objective #90 (Scrotal Mass) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Testicular cancer is the most common malignancy in young men (aged 24–34). Recent advances in management have resulted in dramatic improvement in survival rates (~95%/5-yr survival).

APPLIED SCIENTIFIC CONCEPT

During fetal life, male gonads arise in the retroperitoneum near the kidneys and descend into the scrotum by pushing into the peritoneum and out through the abdominal wall. This concept helps understand the anatomy of the scrotum and the physiopathology of various clinical entities:

- Left gonadal vein drains into the left renal vein (varicocele).
- Liquid accumulating in the tunica vaginalis, which originates from peritoneum (hydrocele)
- Weakness of the abdominal wall at the internal inguinal ring (inguinal hernia)
- Spread of testicular cancer through lymphatics directly to the retroperitoneum

CAUSAL CONDITIONS (Table 23.11)

TABLE 23.11 • Causal conditions of scrotal mass

Scrotal Mass	Definition	Etiologies
Testicular cancer	95% germ cell tumors • Seminomas • Nonseminomas	• Risk factors • Cryptorchidism (up to 14-fold) • Testicular atrophy • Testicular dysgenesis • HIV
Hydrocele	Collection of fluid within the tunica vaginalis, surrounding the testicle	• Idiopathic • Tumor • Epididymitis/orchitis • Trauma • Torsion (reactive)
Hematocele	Collection of blood within the tunica vaginalis. Similarly to a hydrocele, the mass is not separated from the testicle.	• Trauma • Postoperative complication
Communicating hydrocele	Incomplete obliteration of the processus vaginalis, allowing peritoneal fluid to pass into scrotum	• Congenital
Spermatocele/epididymal cyst	Sperm filled collection of the epididymis, resulting in cyst-like structure superior to testicle	• Idiopathic • Associated with von Hippel-Lindau disease
Varicocele	Dilated and tortuous veins of the pampiniform plexus of the spermatic cord	• More common on left side • Right-sided varicocele is less common and may be due to intra-abdominal pathology.
Infectious (orchitis/epididymitis)	Scrotal pain and swelling; associative tenderness and erythema	• < 35 y.o. gonorrhea and chlamydia • > 35 y.o. E. coli

APPROACH

History

A full history should be taken, which includes history of present illness, medical history, surgical history, sexual history, medications, allergies, and social history. Focused history should involve the onset and duration of symptoms, presence of pain, history of trauma or surgery, and if there is an increasing size of the mass. Testicular cancer risk factors should be delineated as outlined above.

Physical Exam

To examine a scrotum, palpating and identifying the intrascrotal contents is key. Assess if mass is part of testicle or separate.

- Testicle and epididymis (located posteriorly and superior to the testicle)
- Spermatic cord (standing position allows searching for varicocele.)
- External inguinal ring (standing with Valsalva)
- In children presenting with a hydrocele, examine while standing and lying down to assess for postural change
- Assess for transillumination (+ for liquid, e.g., hydrocele)
- Varicocele—disappears when supine, most commonly left sided. Needs investigation if does not disappear in supine
- Testicular cancer—painless, firm enlargement of the testicle, 10% painful, intratesticular hemorrhage, symptoms of metastasis—back pain from nodal disease, dyspnea from lung involvement, anorexia, weight loss, supraclavicular node, and gynecomastia

Investigation

Imaging (Optional)

- Scrotal US is the image modality of choice when investigating a scrotal mass.
  - Differentiates cystic from solid lesions
  - Doppler US helps assessing for vascularization (varicocele/torsion).
  - When testis exam is impossible due to an important hydrocele, US should be done to rule out testicular cancer.

Testicular Cancer

- Testicular cancer screening
  - **The Canadian Task Force on Preventive Health Care considers the data insufficient to recommend for or against routine screening or self-exam (C recommendation).**
- Transscrotal biopsy of an intratesticular mass should be **condemned** due to risk of cancer dissemination.
- Metastatic workup
  - Chest x-ray
  - Abdominal and pelvic CT
  - Serum tumor markers (b-hCG/AFP/LDH)

Diagnosis

Most testicular masses are based on clinical suspicion.

- **Hydrocele**—painless scrotal mass, transilluminates, not separated from testicle. 10% are associated with testicular cancer. If unsure, a scrotal US is warranted.
- **Spermatocele/epididymal cyst**—painless smooth and round scrotal mass located superior to the testis. Should be able to distinguish the testicle and mass, separately.
- **Epididymitis/orchitis**—may have history of risky sexual behavior (unprotected intercourse, multiple sexual partners). Other infectious-related symptoms such as urethritis, fevers, chills, or lower urinary tract symptoms may be present. US may reveal *increased* blood flow to testicle. Tender physical exam.
- **Varicocele**—painless "bag of worms," generally resolves in supine position. If right sided and acute onset, this warrants further abdominal imaging to assess for intra-abdominal pathology.
- **Testicular cancer**—firm or hard mass within the testicle, painless. Does not transilluminate. Elevated tumor markers (may have normal markers).

Management (Table 23.12)

TABLE 23.12 • Management of scrotal mass

Hydrocele	Treated with surgical excision, electively if bothersome
Communicating hydrocele	Treated surgically with hernia repair
Spermatocele/epididymal cyst	Treated with surgical excision, electively if bothersome
Varicocele	Surgical ligation of testicular vein
Testicular cancer	Radical inguinal orchidectomy + adjuvant therapy if indicated

SCROTAL PAIN

MCC OBJECTIVE

Based on Objective #91 (Scrotal Pain) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Testicular torsion is a common urologic emergency, requiring urgent surgical intervention. The ability to differentiate testicular torsion from similarly presenting causes of acute scrotal pain is an important clinical skill.

Bell clapper deformity: a common congenital malformation in which the testis is inadequately affixed to the scrotum, found in 40% of men bilaterally and another 17% unilaterally. This absence of a properly formed gubernaculum testis, sometimes referred to as the scrotal ligament, allows the testis to move freely on its axis, rendering it susceptible to torsion.

APPLIED SCIENTIFIC CONCEPT

Testicular torsion: when the spermatic cord twists on itself causing acute testicular torsion, irreversible ischemic injury to the testis may begin as soon as 4 h after occlusion of the cord, with most sources quoting a 6 h window of preservation. If vascular supply is reestablished after 6 h, the chances of testicular preservation decline significantly.

CAUSAL CONDITIONS (Table 23.13)

TABLE 23.13 • Differential diagnosis of an acute scrotum

Anatomical Site	Pathology
Testis	Orchitis, testicular hemorrhage into existing tumour, testicular fracture/rupture (trauma)
Testicular appendix	Torsion of testicular appendix
Epididymis	Acute epididymitis
Spermatic cord	Testicular torsion
Tunica vaginalis	Hematocele (trauma)
Inguinal	Incarcerated/strangulated inguinal hernia
Distal ureter	Referred pain from distal ureteric calculus

APPROACH

History

A thorough history should be conducted with focus on onset and timing of symptoms, history of previous episodes, palliative or aggravating factors, characterization of pain, history of scrotal trauma, and sexual history. Testicular torsion is a medical emergency, which requires prompt surgical intervention. As such, it is important to collect an AMPLE history, including **A**llergies, **M**edications, **P**ast medical history, **L**ast meal, and **E**vents leading up to their presentation. It is also important to determine whether the patient has ever had an anesthetic in the past, and if there were any issues or complications with anesthesia.

Physical Exam

Key Findings

Testicular Torsion

- Absence of cremasteric reflex (elevation of the ipsilateral testicle created by gently scratching the inner superior aspect of the thigh)
- No relief with elevation of testicle (negative Prehn sign)
- Testicle may be high-riding or have a horizontal lie.

Acute Epididymitis

- Presence of cremasteric reflex
- Prehn sign (pain relieved with elevation of testicle)
- Epididymal swelling and focal point of pain

Torsion of the Appendix Testis

- “Blue dot” sign

Investigations

Laboratory investigations should include CBC, electrolytes, BUN, Cr, INR, PTT, and urine analysis and culture. Most episodes of testicular torsion will have normal investigations and are diagnosed based on clinical findings. In patients with debatable clinical findings, Doppler ultrasonography is an important diagnostic tool, which assess for testicular blood flow. STI screening may be indicated if an infectious etiology has been identified as the etiology behind the pain.

Diagnosis

Differentiating testicular torsion from acute epididymitis is an important clinical skill and largely relies on a thorough history and physical exam. In cases of diagnostic ambiguity, an US will provide additional information to rule out testicular torsion. Time is tissue, and a timely diagnosis is essential to provide the best opportunity to save the testicle. After 6 h, irreversible damage begins and the likelihood of "saving" the testicle becomes markedly reduced.

Management

Testicular Torsion

- Manual detorsion may be attempted, cautiously. The examiner may try to detort the testicle in an "open-book" fashion. Generally, it is thought that the testicles twist medially, leading to torsion, and as such, careful lateral detorsion may improve symptoms in some patients. However, this does not eliminate the need for urgent surgical evaluation for definitive testicular affixation (orchiopexy).
- Surgical exploration—in cases with a clear diagnosis of testicular torsion or those with diagnostic ambiguity, surgical exploration is absolutely necessary. As the contralateral testicle is at increased risk of experiencing torsion at a later date, at the time of surgery, bilateral orchiopexy is performed routinely.

Acute Epididymitis

- Ceftriaxone 250 mg IM × 1
- Tetracycline 500 mg PO q.i.d. × 10 d
- Doxycycline 100 mg PO b.i.d. × 10 d
- Evaluate partner
- Counseling regarding safe sexual practices

URINARY TRACT INJURY

MCC OBJECTIVE

Based on Objective #109-14 (Urinary Tract Injuries) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Genitourinary trauma accounts for approximately 10% of emergency visits and is often caused by blunt mechanisms.

CAUSAL CONDITIONS (Table 23.14)

TABLE 23.14 • Causal conditions of urinary tract injury

Organ Involvement	Etiology
Renal trauma	For example, motor vehicle accidents, falls > 80% blunt, < 20% penetrating
Ureter	Iatrogenic, e.g., gynecological, colorectal, and urologic procedures. External trauma is rare.
Bladder	For example, motor vehicle accidents, associated with pelvic fracture, open or laparoscopic pelvic surgery
Urethra	For example, straddle injuries, bicycle riding pelvic fracture, abdominal injury

APPROACh

History

Identifying the mechanism of injury will aid in identification of which organ systems may be involved. If the patient is unconscious or unable to provide an accurate history, then diagnosis will rely on physical exam, laboratory, and imaging findings.

For patients who are able to provide a history, it is important to determine the type of injury, the duration since the incident, and the reason they sought medical care. A thorough history should be documented, which should consist of determining if the patient has nausea or vomiting, abdominal distension, gross hematuria, an inability to void, or flank pain. It is important to determine if the patient has any bleeding risk factors such as current anticoagulant therapy, familial bleeding disorders, or massive transfusion as part of their resuscitation.

Physical Exam

As with all trauma patient encounters, ATLS (Advanced Trauma and Life Support) principles apply:

- Primary survey
  - A: airway with C-spine protection
  - B: breathing, with adequate oxygenation
  - C: circulation, control of extra hemorrhage, two large-bore IVs
  - D: disability—assessment of neurologic status
  - E: exposure/environment—undress/temperature control
- Adjuncts as indicated
  - EKG, CXR, Foley catheter, NG tubes, ABGs, FAST exam
- Secondary survey—performed when HD stability has been restored and 1° survey complete
  - Complete history and physical exam

Signs and Symptoms of Genitourinary System Injury

Renal Trauma

- Flank bruising, palpable mass, pain, tenderness
- Hematuria (gross or microscopic)

Ureteral Trauma

- Iatrogenic causes are mostly diagnosed postoperatively.
- Flank pain, fever, sepsis, urinoma, prolonged ileus, acute kidney injury

Bladder Injury

- 95% of patients have gross hematuria.
- Suprapubic pain, bruising, pelvic mass, urinary retention, peritonitis

Urethral Injuries

- Great majority associated with pelvic fractures
- Blood at the tip of the meatus, hematuria, perineal or scrotal bruising (butterfly hematoma), high-riding prostate, urinary retention, *penile swelling*

Investigations

CBC, electrolytes, creatinine, BUN, urinalysis

Renal Injury

- CT imaging is warranted for patients with hemodynamic instability and gross hematuria. This should include *delayed view* (CT-IVP).

Ureteral Injury

- Contrast-enhanced CT with delayed imaging to assess for contrast leakage retrograde pyelography

Bladder Injury

- For patients with a history suggestive of bladder injury, a cystogram should be performed to assess for extravasation of contrast.

Urethral Injury

- A retrograde urethrogram should be performed in any case of suspected urethral injury.

Management

Renal

- The vast majority of renal trauma can be managed conservatively with ABCs, admission, bed rest until gross hematuria clears, close clinical observation, serial CBC. If significant bleeding including hemodynamic instability or ongoing bleeding persists, urgent urologic consultation is warranted for either surgical exploration or angioembolization. Urinary leakage also warrants consultation and possible urinary drainage (double J stent).

Ureter
- Can consider nephrostomy tube until patient becomes stable to undergo surgical repair

Bladder
- Extraperitoneal rupture—Foley catheter
- Intraperitoneal rupture—surgical repair

Urethra
- If there is blood at the tip of the meatus, do not insert Foley catheter. Needs immediate urologic consultation for retrograde urethrography and possible cystourethroscopy to assess injury or suprapubic tube insertion.

URINARY TRACT OBSTRUCTION

MCC OBJECTIVE

Based on Objective #111 (Urinary Tract Obstruction) of *Objectives for the Qualifying Examination*, 3rd edition.

OVERVIEW

Complete urinary tract obstruction is a medical emergency and can lead to significant pain and discomfort for the patient. Immediate intervention is required for pain relief and renal preservation.

APPLIED SCIENTIFIC CONCEPT

When patients present with acute kidney injury, differentiating prerenal, renal, and postrenal is essential for proper management.

Although unilateral urinary obstructions have repercussions on the ipsilateral kidney, global renal function is generally not altered as long as the contralateral kidney functions normally.

Classification of urinary obstruction:
- Acute or chronic
- Complete or partial
- Unilateral (usually upper tract) or bilateral (usually lower tract)

Hypertension

- Hypertension due to unilateral obstruction is secondary to vasoconstriction resulting from activation of renin-angiotensin.
- Hypertension due to bilateral obstruction is secondary to volume expansion.

CAUSAL CONDITIONS (Table 23.15)

TABLE 23.15 • Causes of urinary obstruction (not exhaustive)

Infections and inflammations	Prostatitis (e.g., post prostate biopsy), cancer (bladder, ureter, prostate)
Structural	Stones, tumors, prolapse, stricture, benign prostatic hypertrophy
Medical conditions	Diabetes mellitus, multiple sclerosis, stroke, disk herniation, immobilization
Drugs	Anticholinergics, narcotics

APPROACH

History and Physical Exam (Table 23.16)

TABLE 23.16 • Signs and symptoms of urinary obstruction

Urinary Tract	Symptoms	Physical Exam Findings
Lower tract	Voiding LUTS • Hesitancy • Weak stream • Postvoid dribbling • Frequency, nocturia, urgency • Inability to empty bladder • Hematuria ± clots	Hypertension Palpable bladder Palpable urethral stricture Enlarged prostate
Upper tract	• Flank pain ± radiation to groin or RLQ or LLQ • Hematuria • GI symptoms (nausea/vomiting)	Hypertension Costovertebral tenderness

CLINICAL box

Urinary obstruction with fever and chills is a urologic emergency. Urine flow must be restored to prevent septicemia and subsequent septic shock. Management includes insertion of nephrostomy tube or ureteric stent with IV antibiotics.

Renal Colic

Clinical presentation varies according to stone location.

- *Ureteropelvic junction*—renal colic with flank pain
- *Pelvic brim* (as ureter crosses iliacs)—can present as RLQ pain or LLQ pain. May mimic: appendicitis, diverticulitis, or ectopic pregnancy.
- *Ureterovesical junction*—renal colic with irritative (urgency, dysuria, frequency) lower urinary tract symptoms and radiation to ipsilateral testicle

Investigation

LUTS of Obstruction

- Standardized questionnaire (IPSS)
- Laboratory:
  - Mandatory: urinalysis, urine culture
  - Optional: CBC, serum creatinine, BUN, electrolytes, blood glucose, PSA
- Others:
  - Bladder scan/urinary catheter for evaluation of postvoid residual
  - Cystoscopy
  - Uroflow
  - US/CT scan
    - *Upper tract imaging* if complications (hematuria, infection, stones)
  - Transrectal US-guided (TRUS) prostate biopsy
    - Diagnostic method of prostate cancer

Upper Tract Obstruction

- Laboratory:
  - Urinalysis, urine culture, serum creatinine, and electrolytes
- US
  - Assessment of hydronephrosis and bladder residual volume
- CT scan
  - Without contrast: easier to see stones
  - With contrast: for lesions other than stones responsible for hydronephrosis
- Renal scintigraphy (DTPA or MAG-3 with furosemide)
  - Functional evaluation of the kidneys. Assessment of urinary obstruction.
- Other urologic investigations
  - Cystoscopy
  - Retrograde pyelography
  - Ureteroscopy (direct visualization, biopsy, and/or treatment)

Diagnosis

- When patients present with anuria or unexplained renal insufficiency, differentiate an obstructive condition from a nonobstructive acute renal insufficiency
  - Imagery
    - If a renal or prerenal cause of acute renal insufficiency is responsible for anuria, the collecting system and bladder should not be dilated.
    - No anuria in unilateral ureteral obstruction
- Volume of the prostate does not always correlate with LUTS. Prostatic enlargement secondary to BPH may be present without bladder outlet obstruction.

Management

Acute treatment for urinary retention (patients presenting with suprapubic discomfort, minimal to no urine output, and severe need to void) requires urgent catheterization—typically elderly male patients.

Lower Tract Urinary Symptoms of Obstruction

- Patients with obstructive LUTS do not require more investigation than history, physical exam, and urinalysis if BPO - benign prostatic obstruction.
  - Treatments depend on severity of symptoms.
    - Observation
    - Medical
      - a -Blockers (symptomatic treatment)
      - 5a -reductase inhibitors (shrinks volume of prostate)
    - Surgical
      - TURP
      - Laser photo-vaporization
      - Open simple prostatectomy

Upper Tract Obstruction

A urinary obstruction with a septic state (fever) is a urologic emergency. Urine flow must be reestablished with a percutaneous nephrostomy tube or a double J catheter promptly to prevent pyonephrosis (kidney becomes pus) and death from septic shock.

Stone Management

Indications for Hospital Admission

- Pain only controlled with IV analgesics
- Intractable nausea and vomiting
- Obstructing stone in solitary kidney
- Bilateral obstructing stones
- Acute kidney injury

Conservative

- Calculus < 5 mm has a 90% chance of passing spontaneously.
- a -Blockers
- Analgesics
- Hydration (> 2 L/d)

Surgical (Urology Referral)

Any of the indications above, as well as either:

- Stones that have not progressed for 2 wk
- Continued pain and discomfort

For the differences between benign prostatic hyperplasia and prostate cancer, see Table 23.17.

TABLE 23.17 • Benign prostatic hyperplasia versus prostate cancer

	Benign Prostatic Hyperplasia	Prostate Cancer
Risk factors	Age, family history	Age, family history, African American
Pathology	Hyperplasia of transitional zone	Adenocarcinoma (95%) • Peripheral zone (60%–70%) • Transitional zone (10%–20%) • Central zone (5%–10%)

(continued)

TABLE 23.17 • (continued)

	Benign Prostatic Hyperplasia	Prostate Cancer
Clinical presentation	Frequency, urgency, nocturia, weak stream, dribbling, hesitancy, intermittency, feeling of not emptying well	Asymptomatic LUTS (locally advanced disease) Bone pain (metastasis)
Physical exam	DRE—enlarged, firm	DRE—normal, nodular, indurated
Labs	Urinalysis (ensure UTI is not causing symptoms), creatinine	PSA
Investigations	± Cystoscopy or urodynamics	TRUS-guided needle biopsy Bone scan (if signs of metastasis)
Treatment	Medical • a-Blockers • 5a-reductase inhibitors Surgical • Transurethral resection of the prostate	Will depend on a number of factors For localized disease: • Active surveillance • Radical prostatectomy • Brachytherapy • External beam radiotherapy • Cryotherapy • HIFU For locally advanced or metastatic PCA: • Androgen deprivation therapy • Systemic therapy (chemotherapy)

SUGGESTED READINGS

Canadian Urology Association. *Canadian Urology Association Guidelines*. Dorval, QC: Canadian Urology Association. https://www.cua.org/en/guidelines

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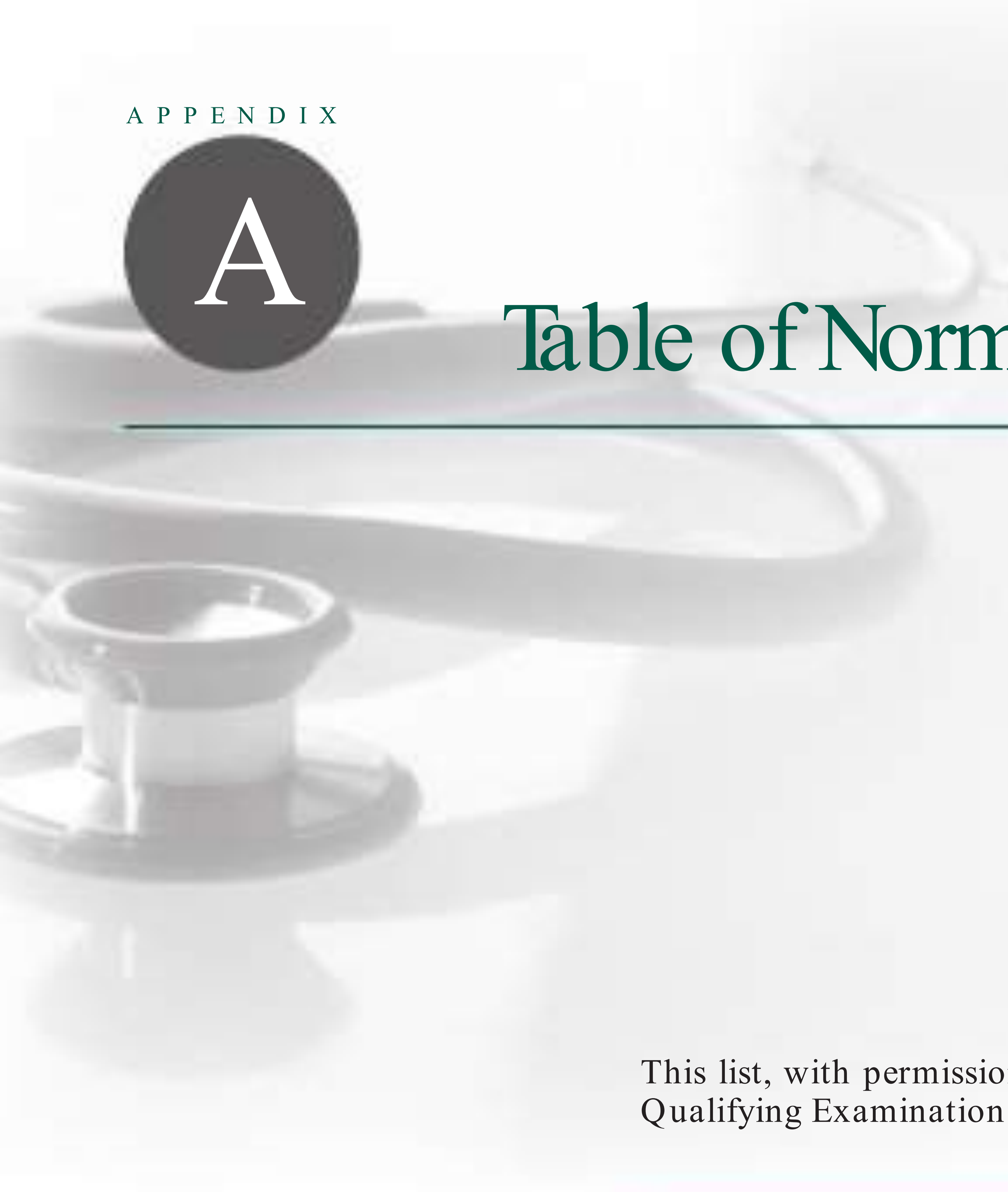

APPENDIX

A

Table of Normal Lab Values

This list, with permission, from the Medical Council of Canada Objectives for the Qualifying Examination (3rd Edition, December 2015).

Blood

Coagulation (Hemostasis)	
Bleeding Time (Ivy)	< 9 min
International Normalized Ratio (INR)	0.9–1.2
Partial Thromboplastin Time (PTT)	28–38 s
Prothrombin Time (PT)	10–13 s
Hemogram	
Hematocrit (Hct)	
Female	0.370–0.460
Male	0.380–0.500
Hemoglobin (Hb)	
Female	123–157 g/L
Male	130–170 g/L
Mean Corpuscular Volume (MCV)	80–100 fL
Mean Corpuscular Hemoglobin (MCH)	27–34 pg
Platelet Count	130–400 × 10^9/L
Red Blood Cells (RBCs)	
Female	4.0–5.2 × 10^{12}/L
Male	4.4–5.7 × 10^{12}/L
Red Cell Distribution Width (RDW)	11.5–14.5%
Reticulocyte Count	20–84 × 10^9/L
Erythrocyte Sedimentation Rate (Westergren)	
Female	< 10 mm/h
Male	< 6 mm/h
White Blood Cells and Differential	
White Blood Cell Count (WBC)	4–10 × 10^9/L
Segmented Neutrophils	2–7 × 10^9/L
Band Neutrophils	< 0.7 × 10^9/L
Basophils	< 0.10 × 10^9/L

Eosinophils	$< 0.45 \times 10^9$/L
Lymphocytes	$1.0–4.0 \times 10^9$/L
Monocytes	$0.1–1.0 \times 10^9$/L
Chemical Constituents	
Albumin (Serum)	35–50 g/L
Alkaline Phosphatase (Serum)	38–126 U/L
Aminotransferase (Transaminase) (Serum)	
Alanine (ALT; SGPT)	17–63 U/L
Aspartate (AST; SGOT)	18–40 U/L
γ-Glutamyl Transferase	
Female	10–30 U/L
Male	10–48 U/L
Amylase (Serum)	< 160 U/L
Bicarbonate (HCO_3^-) (Serum)	24–30 mmol/L
Bilirubin (Serum)	
Direct (Conjugated)	< 7 µmol/L
Total	< 26 µmol/L
Calcium (Ca^{2+}) (Serum)	
Total	2.18–2.58 mmol/L
Ionized	1.05–1.30 mmol/L
Chloride (Cl^-) (Serum)	98–106 mmol/L
Cholesterol (Serum)	< 5.2 mmol/L
Low Density Lipoprotein (LDL)	< 3.37 mmol/L for low risk
Low Density Lipoprotein (LDL)	< 2.0 mmol/L for high risk
High Density Lipoprotein (HDL)	> 0.9 mmol/L
Cortisol	160–810 mmol/L
Creatine Kinase (CK) (Serum)	20–215 U/L
Creatinine (Cr) (Serum)	
Female	50–90 µmol/L
Male	70–120 µmol/L
Ferritin	
Female	11–307 µg/L
Male	24–336 µg/L
Folic (Folate)	> 15 nmol/L
Glucose Fasting (Serum)	3.3–5.8 mmol/L
Hemoglobin A_1C	4–6%
Iron (Fe^{2+}) (Serum)	11–32 µmol/L
Lactate Dehydrogenase (LDH) (Serum)	95–195 U/L
Lipase (Serum)	< 160 U/L
Magnesium (Mg^{2+}) (Serum)	0.75–0.95 mmol/L
Osmolality (Serum)	280–300 mmol/kg
Oxygen (O_2) Saturation (Arterial Blood) (S_aO_2)	96–100%
P_aCO_2 (Arterial Blood)	35–45 mm Hg
P_aO_2 (Arterial Blood)	85–105 mm Hg
pH	7.35–7.45
Phosphorus (P^{3-}) (Inorganic) (Serum)	0.8–1.5 mmol/L
Potassium (K^+) (Serum)	3.5–5.0 mmol/L
Prostate Specific Antigen (PSA)	0–4 µg/L
Protein (Serum)	
Total	60–80 g/L
Albumin	35–50 g/L
Sodium (Na^+) (Serum)	135–145 mmol/L
Thyroid-Stimulating Hormone (TSH)	0.4–5.0 mU/L
T_3 (Free)	3.5–6.5 pmol/L
T_4 (Free)	8.5–15.2 pmol/L
Total Iron Binding Capacity (TIBC)	45–82 µmol/L

Transaminase—see Aminotransferase	
Triglycerides (Serum)	< 1.7 mmol/L
Troponin T (TnT)	< 0.01 μg/L
Urea Nitrogen (BUN) (Serum)	2.5–8.0 mmol/L
Uric Acid (Serum)	180–420 μmol/L
Vitamin B_{12}	133–674 pmol/L

Cerebrospinal Fluid

Cell Count	$< 10 \times 10^6$/L
Glucose	2–4 mmol/L
Proteins (Total)	0.20–0.45 g/L

Urine

Calcium (Ca^{2+})	< 7.3 mmol/d
Chloride (Cl^-)	110–250 mmol/d
Creatinine (Cr)	6.2–17.7 mmol/d
Osmolality	100–1200 mOsm/kg
Potassium (K^+)	25–120 mmol/d
Protein	< 0.15 g/d
Sodium (Na^+)	25–260 mmol/d

APPENDIX

B

List of Abbreviations

Abbreviation	Expansion
↑	Increase
Sao_2	Oxygen Saturation
#	Fracture
#	Number of
N/C	Normal
↓	Decrease
$-Na^+$	Sodium Deficit
♀	Female
♂	Male
1°	Primary
17-OH-P	17-Hydroxyprogesterone
2°	Secondary
2-h PPG	Two-Hour Postprandial Glucose
5-HIAA	5-Hydroxyindoleacetic acid
5-HT	Serotonin
5-HT_3	5-Hydroxytryptamine
99mTc	Technetium-99 m
AA	Afferent Arteriole
AA	Aortic Aneurysm
AAA	Abdominal Aortic Aneurysm
AACG	Acute Angle Closure Glaucoma
AAP	Acute Abdominal Pain
AAT	Activity As Tolerated
Ab	Antibody/Antibodies
ABC	Airway, Breathing, Circulation
Abdo	Abdomen, Abdominal
ABG	Arterial Blood Gas
ABI	Ankle Brachial Index
AbN	Abnormal
ABO	Blood Group System of Groups A, AB, B, and O
Abx	Antibiotic
Abx Tx	Antibiotherapy
AC	Alternating Current
AC	Activated Charcoal
AC	Air Conduction
AC	Acromioclavicular
AC Fossa	Antecubital Fossa

AC/A	Ratio of Accommodative Convergence/ Accommodation
AC/MDAC	Activated Charcoal/Multidose Activated Charcoal
ACA	Anterior Cerebral Artery
ACD	Acute Adrenal Insufficiency
ACE	Angiotensin Converting Enzyme
ACEI	Angiotensin Converting Enzyme Inhibitor
AChR	Acetylcholine Receptor
ACL	Anterior Cruciate Ligament
ACLS	Advanced Cardiac Life Support
ACS	Acute Coronary Syndrome
ACT	Assertive Community Treatment
ACTH	Adrenocorticotropic Hormone
AD	Advanced Directive
AD	Anxiety Disorder
ADH	Antidiuretic Hormone, Vasopressin
ADHD	Attention Deficit/Hyperactivity Disorder
ADL	Activity of Daily Living
ADM	Abductor Digiti Minimi
AED	Antiepileptic Drug
AFB	Acid-fast Bacillus
AFFIRM	Atrial Fibrillation Follow-up Investigation of Rhythm Management
AFI	Amniotic Fluid Index
AFib	Atrial Fibrillation
AFL	Atrial Flutter
AFP	Alpha Fetoprotein
AFV	Amniotic Fluid Volume
Ag	Antigen
AG	Anion Gap
AGUS	Atypical Glandular Cells of Uncertain Significance
AI	Aortic Insufficiency
AI	Adrenal Insufficiency
AI	Autoimmune
AIDS	Acquired Immunodeficiency Syndrome
AIMS	Abnormal Involuntary Movement Scale
AION	Anterior Ischemic Optic Neuropathy
ALL	Acute Lymphocytic Leukemia
ALP	Alkaline Phosphatase
ALS	Amyotrophic Lateral Sclerosis
ALT	Alanine Transaminase
ALT	Alanine Aminotransferase
AMA	Antimitochondrial Antibodies
AMD	Age-Related Macular Degeneration
AML	Acute Myeloid Leukemia
AN	Anorexia Nervosa
ANA	Antinuclear Antibody
ANC	Absolute Neutrophil Count
ANCA	Anti-neutrophil Cytoplasmic Antibody
ANP	Atrial Natriuretic Peptide
Anti-dsDNA	Anti-double-stranded Deoxyribonucleic Acid
Anti-GBM	Anti-glomerular Basement Membrane
Anti-LKM	Antibodies to Liver/Kidney Microsomes
anti-PL	Antiphospholipid Antibodies
anti-Sm	Anti-Smith
Anti-SMA	Antibodies to Smooth Muscle Actin
Ao	Aortic
AOM	Acute Otitis Media
AP	Anterior Posterior
APB	Abductor Pollicis Brevis
APC-resistance	Activated protein C Resistance

APH	Antepartum Hemorrhage
API	Arterial Pressure Index
APL	Abductor Pollicis Longus
aPTT	Activated Partial Thromboplastin Time
AR	Aortic Regurgitation
ARB	Angiotensin Receptor Blocker
ARDS	Acute Respiratory Distress Syndrome
ARF	Acute Renal Failure
ARM	Anorectal Manometry
AS	Aortic Stenosis
AS	Ankylosing Spondylitis
ASA	Acetylsalicylic Acid (Aspirin)
ASAP	As Soon As Possible
ASC	Applied Scientific Concepts
ASCA	Anti-*Saccharomyces cerevisiae* Antibody
ASC-H	Atypical Squamous Cell, cannot exclude HSIL
ASCUS	Atypical Squamous Cells of Undetermined Significance
ASD	Atrial Septal Defect
ASIA	American Spinal Injury Association
ASO	Anti-streptolysin O
ASOT	Anti-streptolysin O Titer
ASPS	Advanced Sleep Phase Syndrome
AST	Aspartate Aminotransferase
AST	Aspartate Transaminase
ASx	Asymptomatic
ATLS	Advanced Trauma Life Support
ATN	Acute Tubular Necrosis
ATP	Adenosine Triphosphate
ATPase	Adenosine Triphosphatase
AUB	Abnormal Uterine Bleeding
AutoAb	Autoantibody
AV	Atrioventricular
AV	Arteriovenous
Avg.	Average
AVM	Arteriovenous Malformation
AVN	Avascular Necrosis
AVNRT	Atrioventricular Nodal Reentrant Tachycardia
AVRT	Atrioventricular Reentrant Tachycardia
AxND	Axillary Node Dissection
AXR	Abdominal X-ray
B. burgdorferi	*Borrelia burgdorferi*
B. cereus	*Bacillus cereus*
b.i.d.	Two Times a Day
BAL	Bronchoalveolar Lavage
BBB	Blood–Brain Barrier
BBP	Biophysical Profile
BBT	Basal Body Temperature
BC	British Columbia
BC	Bone Conduction
BCC	Basal Cell Carcinoma
BCG	Bacille Calmette-Guérin
BG	Blood Glucose
b-HCG	b-Human Chorionic Gonadotropin
BiPAP	Bilevel Positive Airway Pressure
BMD	Bone Mineral Density
BMI	Body Mass Index
BMR	Basal Metabolic Rate
BN	Bulimia Nervosa
BNP	Brain Natriuretic Peptide

BP	Blood Pressure
BP	Bipolar Disorder
BPE	Boiling Point Elevation
BPH	Benign Prostatic Hyperplasia
BPP	Biophysical Profile
BPPV	Benign Paroxysmal Positional Vertigo
BRAO	Branch Renal Artery Occlusion
BRCA	Breast Cancer
bs	Bowel Sounds
B-S	Bernard-Soulier Disease
BSO	Bilateral Salpingo-Oophorectomy
BUN	Blood Urea Nitrogen
BV	Blood Volume
BV	Bacterial Vaginosis
C&S	Culture and Sensitivity
C.	Corynebacterium
C. albicans	*Candida albicans*
C. difficile	*Clostridium difficile*
C. glabrata	*Candida glabrata*
C. perfringens	*Clostridium perfringens*
C. pneumoniae	*Chlamydia pneumoniae*
c.a.	Carbonic Anhydrase
C/S	Cesarean Section
C_2 LEO	Cultural-Communication Legal, Ethical, and Organizational
CA	Cancer
CA	Carbohydrate Antigen
Ca^{2+}	Calcium
CABG	Coronary Artery Bypass Graft Surgery
CAD	Coronary Artery Disease
CAEP	Canadian Association of Emergency Physicians
CAH	Congenital Adrenal Hyperplasia
CAH	Congenital Adrenal Hypertrophy
CAM	Cystic Adenomatoid Malformation
CAM	Complementary and Alternative Medicines
cAMP	Cyclic Adenosine Monophosphate
c-anca	Cytoplasmic-Staining Anti-neutrophil Cytoplasmic Antibodies
C-ANCA	Cytoplasmic Anti-neutrophil Cytoplasmic Antibodies
CANMAT	Canadian Network for Mood and Anxiety Treatments
CAP	Community-Acquired Pneumonia
CaP	Carcinoma of the Prostate
CAS	Children’s Aid Society
Cath	Catheterization
CB1	Cannabinoid Receptor
CBC	Complete Blood Count
CBC-D	Complete Blood Count with Differential
CBF	Cerebral Blood Flow
CBS	Capillary Blood Sugar
CBT	Cognitive Behavioral Therapy
CCAM	Congenital Cystic Adenomatoid Malformation
CCB	Calcium Channel Blocker
CCCT	Clomiphene Citrate Challenge Test
CCD	Cortical Collecting Duct
CCR	Canadian C-Spine Rule
CCU	Coronary Care Unit
CDH	Congenital Diaphragmatic Hernia
CDM	Clinical Decision Making
CEA	Carcinoembryonic Antigen

CF	Cystic Fibrosis
CFCP	Certified Functional Continuity Professional
CFPC	College of Family Physicians of Canada
cGMP	Cyclic Guanosine Monophosphate
CHA	Canada Health Act
CHD	Coronary Heart Disease
Chemo	Chemotherapy
CHF	Congestive Heart Failure
CHL	Conductive Hearing Loss
Chr	Chromosome
Chron.	Chronic
CI	Contraindication
CIHR	Canadian Institutes for Health Research
CIN	Cervical Intraepithelial Neoplasia
CIS	Carcinoma *In Situ*
CJD	Creutzfeldt-Jakob Disease
CK	Creatine Kinase
CKD	Chronic Kidney Disease
Cl^-	Chloride
CL	Corpus Luteum
CLL	Chronic Lymphocytic Leukemia
cm	Centimeter
CMA	Canadian Medical Association
CMC	Carpometacarpal
CME	Continuing Medical Education
CMI	Cell-Mediated Immunity
CML	Chronic Myeloid Leukemia
CMPA	Canadian Medical Protective Association
CMV	Cytomegalovirus
CN	Cranial Nerve
CNS	Central Nervous System
CO	Cardiac Output
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CoA	Coarctation of the Aorta
CO-Hgb	Carboxyhemoglobin
COPD	Chronic Obstructive Pulmonary Disease
COX	Cyclooxygenase
coxibs	Selective Inhibitors of Cyclooxygenase-2
CP	Cerebral Palsy
CPA	Cerebello-pontine Angle
CPAP	Continuous Positive Airway Pressure
CPB	Cardiopulmonary Bypass
CPD	Cephalopelvic Disproportion
CPDD	Calcium Pyrophosphate Deposition Disease
CPP	Cerebral Perfusion Pressure
CPP	Chronic Pelvic Pain
CPR	Cardiopulmonary Resuscitation
Cr	Creatinine
CRAO	Central Renal Artery Occlusion
CRAO	Central Retinal Artery Occlusion
CrCl	Creatinine Clearance
CRF	Chronic Renal Failure
CRH	Corticotropic-Releasing Hormone
CRP	C-Reactive Protein
CRPS	Complex Regional Pain Syndrome
CRVO	Central Renal Vein Occlusion
CRVO	Central Retinal Vein Occlusion
CSF	Cerebrospinal Fluid
CT	Computed Tomography
CT	Connective Tissue

CT/PE	Computed Tomography for Pulmonary Embolism
CTA	CT Angiogram
CTD	Connective Tissue Disease
CTG	Continuous Cardiotocography
CV	Cardiovascular
CVA	Cerebrovascular Accident
CVA	Costovertebral Angle
CVD	Coronary Vascular Disease
CVD	Cardiovascular Disease
CVD	Cerebrovascular Disease
CVP	Central Venous Pressure
CVR	Cerebrovascular Resistance
CVS	Cardiovascular System
CVS	Chorionic Villus Screening
CXR	Chest X-ray
d	Day
Δ	Change
Δ	Difference
D&E	Dilation and Evacuation
D/C	Discharge
d/c	Discontinue
D/O	Disorder
D_2	Dopamine Receptor Subtype 2
D50W	50% Dextrose in Water
D5W	5% Dextrose in Water
DA	Dopamine
DB	Diabetes
DBP	Diastolic Blood Pressure
DBT	Dialectical Behavioral Therapy
DC	Direct Current
DCM	Dilated Cardiomyopathy
DCT	Distal Convoluted Tubule
DDAVP	Desmopressin Acetate
DDAVP	1-Deamino-8-D-Arginine-Vasopressin (Desmopressin)
DDH	Developmental Dysplasia of the Hip
DDx	Differential Diagnosis
Derm	Dermatology
DES	Diethylstilbestrol
DHE	Dihydroergotamine
DHEAS	Dehydroepiandrosterone Sulfate
DI	Diabetes Insipidous
diastol	Diastolic
DIC	Disseminated Intravascular Coagulation
DIOS	Distal Intestinal Obstruction Syndrome
DIP	Distal Interphalangeal Joint
DJ	Disco Jockey
DKA	Diabetic Ketoacidosis
DLCO	Diffusion Capacity of Carbon Monoxide
DM	Diabetes Mellitus
DM	Dermatomyositis
DM2	Type 2 Diabetes Mellitus
DMARD	Disease-Modifying Antirheumatic Drug
DMPA	Depot Medroxyprogesterone Acetate
DMSA	Dimercaptosuccinic Acid
DOC	Deoxycorticosterone
DPL	Diagnostic Peritoneal Lavage
DPN	Diagnosis and Prevention Network
DRE	Digital Rectal Exam
DSM	Diagnostic and Statistical Manual of Mental Disorders

DSPS	Delayed Sleep Phase Syndrome
DTaP-IPV	Diphtheria, Tetanus, acellular Pertussis, Inactivated Polio Virus
DTR	Deep Tendon Reflex
DVT	Deep Vein Thrombosis
DWI	Diffusion Weighted Imaging
Dx	Diagnosis
DXA	Dual Energy X-ray Absorptiometry
dz	Disease
E	Estrogen
E.	Eustachian
E. coli	*Escherichia coli*
E. histolytica	*Entamoeba histolytica*
E. vermicularis	*Enterobius vermiculis*
EA	Efferent Arteriole
EA	Enteropathic Arthritis
EABV	Effective Arterial Blood Volume
EB	Epidermolysis Bullosa
EBM	Evidence-Based Medicine
EBV	Epstein-Barr Virus
EC	Emergency Contraception
ECA	External Carotid Artery
ECF	Extracellular Fluid
ECG	Electrocardiogram
ECHO	Echocardiogram
ECP	Emergency Contraceptive Pills
ECRB	Extensor Carpi Radialis Brevis
ECRL	Extensor Carpi Radialis Longus
ECT	Electroconvulsive Therapy
ECU	Extensor Carpi Ulnaris
ECV	Effective Circulating Volume
ED	Emergency Department
ED	Erectile Dysfunction
EDC	Expected Date of Conception
EDM	Extensor Digiti Minimi
EDTA	Ethylene Diamine Tetraacetate
EDV	End-Diastolic Volume
EE	Ethinyl Estradiol
EEG	Electroencephalogram
EENT	Eye, Ear, Nose, Throat
EF	Ejection Fraction
Eff	Effusion
EFM	Electronic Fetal Monitoring
EFW	Estimated Fetal Weight
EGD	Esophagogastroduodenoscopy
EI	Extensor Indicis
ELISA	Enzyme-Linked Immunosorbent Assay
emerg	Emergency/ies
EMG	Electromyography
EMLA	Lidocaine + Prilocaine
EMS	Emergency Medical Services
ENG	Electronystagmography
ENT	Ears, Nose, Throat
EOM	Extraocular Muscle/Movement
EP	Electrophysiology
EP	Ectopic Pregnancy
EPB	Extensor Pollicis Brevis
EPI	Epinephrine
EPL	Extensor Pollicis Longus
EPO	Erythropoietin
EPS	Extrapyramidal Side Effects

EPT	Estrogen Progesterone Therapy
ER/PR	Estrogen/Progesterone Receptor
ERCP	Endoscopic Retrograde Cholangiopancreatography
ESR	Erythrocyte Sedimentation Rate
ESRD	End-stage Renal Disease
ESRF	End-stage Renal Failure
ET	Estrogen Therapy
ETCO	End-tidal Carbon Monoxide
EtOH	Alcohol
ETT	Endotracheal Tube
EWN	Edinger-Westphal Nuclei
exam	Examination
exp	Expiratory
Ext.	Extension
F/P/T	Federal/Provincial/Territorial
F/U	Follow Up
F:M	Female:Male ratio
FA	Fatty Acid
FAI	Femoroacetabular Impingement
FAP	Familial Adenomatous Polyposis
FAS	Fetal Alcohol Syndrome
FAST	Focused Assessment with Sonography for Trauma
FB	Foreign Body
FCR	Flexor Carpi Radialis
FCU	Flexor Carpi Ulnaris
FDMB	Flexor Digiti Minimi Brevis
FDP	Flexor Digitorum Profundus
FDS	Flexor Digitorum Superficialis
FE	Fractional Excretion
Fe^{2+}	Iron
FE_K	Fractional Excretion of Potassium
FE_{Na}	Fractional Excretion of Sodium
FEV	Forced Expiratory Volume
FEV_1	Forced Expiratory Volume in 1 Second
FFA	Free Fatty Acid
fFN	Fetal Fibronectin
FFN	Fetal Fibronectin
FFP	Fresh Frozen Plasma
FFS	Fee-For-Service
FHA	Functional Hypothalamic Amenorrhea
FHR	Fetal Heart Rate
FHx	Family History
Fio_2	Fractional Content of Inspired Oxygen
Fl	Femtoliter
Flex.	Flexion
Flu	Influenza
FM	Fibromyalgia
FMMSE	Folstein Minimental Status Exam
FMP	Final Menstrual Period
FMR1	Fragile X Mental Retardation I
FNAB	Fine Needle Aspiration Biopsy
FNAC	Fine Needle Aspiration Cytology
FNIHB	First Nations and Inuit Health Branch
FOB	Fecal Occult Blood
FOBT	Fecal Occult Blood Test
FPB	Flexor Pollicis Brevis
FPD	Freeze Point Depression
FPG	Fasting Plasma Glucose
FPL	Flexor Pollicis Longus
FRC	Functional Residual Capacity
FRS	Framingham Risk Score

FSGS	Focal Segmental Glomerulosclerosis
FSH	Follicle-Stimulating Hormone
FT$_4$	Free T$_4$
FTA-ABS	Fluorescent Treponemal Antibody-Absorbed
FTP	Failure to Progress
FTS	First Trimester Screening
FTT	Failure to Thrive
FUO	Fever of Unknown Origin
FVC	Forced Vital Capacity
fx	Features
fxn	Function
g	Gram
G&S	Blood Group and Screen
G. vaginalis	*Gardnerella vaginalis*
g/L	Grams per Liter
G6PD	Glucose-6-Phosphate Dehydrogenase Deficiency
GA	Gestational Age
GABA	g-Aminobutyric Acid
GABHS	Group A b-Hemolytic Streptococci
GAS	Group A *Streptococcus*
GBM	Glomerular Basement Membrane
GBS	Group B *Streptococcus*
GBS	Guillain-Barré Syndrome
GC	Glucocorticoid
GCA	Giant Cell Arteritis
GCS	Glasgow Coma Score
GDD	Global Developmental Delay
GDM	Gestational Diabetes Mellitus
gen	Generation
GER	Gastroesophageal Reflux
GERD	Gastroesophageal Reflux Disease
GFR	Glomerular Filtration Rate
GGT	g–Glutamyl Transferase
GH	Growth Hormone
GH	Glenohumeral
GI	Gastrointestinal
GIFT	Gamete Intrafallopian Transfer (immediate transfer with sperm after oocyte retrieval)
gluc	Glucose
GLUT5	Glucose Transporter 5
GMC	General Medical Conditions
GN	Gram Negative
GN	Glomerulonephritis
GnRH	Gonadotropin-Releasing Hormone
GPe	Globus Pallidus Externa
GPIIb	Glycoprotein IIb Inhibitors
GRE	Gradient Recalled Echo
GSI	Gonadosomatic Index
GTC	Generalized Tonic-Clonic
GTD	Gestational Trophoblastic Disease
GU	Genitourinary
h	Hour
H&N	Head and Neck
H. ducreyi	*Haemophilus ducreyi*
H. flu	*Haemophilus influenza*
H. flu	*Haemophilus influenzae*
h/a	Headache
H/H	Hemoglobin and Hematocrit
H$_1$	Histamine Receptor 1
H$_2$	Histamine Receptor 2
H$_2$	Hydrogen Gas

H_2 blockers	Histamine 2 Receptor Blockers
H_2O	Water
H_2RA	H_2-Receptor Antagonist
H_2S	Hydrogen Sulfide
HAV	Hepatitis A Virus
Hb	Hemoglobin
HbA_{1c}	Glycosylated Hemoglobin
HBcAg	Hepatitis B Core Antigen
HBIG	Hepatitis B Immunoglobulin
HBsAg	Hepatitis B Surface Antigen
HBV	Hepatitis B Virus
HCC	Hepatocellular Carcinoma
HCCA	Health Care Consent Act
hCG	Human Chorionic Gonadotropin
HCl	Hydrochloric Acid
HCO_3^-	Bicarbonate
Hct	Hematocrit
HCV	Hepatitis C Virus
HD	Hemodialysis
HD	Hirschsprung Disease
HDL	High Density Lipoprotein
HELLP	Hemolysis, Elevated Liver Enzymes, Low Platelets
HEME	Hematology
Hep B	Hepatitis B
HepBsAg	Hepatitis B Surface Antigen
Her2/neu	Human Epidermal Growth Factor Receptor 2
HERS	Heart and Estrogen/Progestin Replacement Study
HF	Hydrofluoric Acid
Hgb	Hemoglobin
HHS	Hyperglycemic Hyperosmolar State
HiB	*Haemophilus influenzae* Type B
HIDA	Hepatobiliary Iminodiacetic Acid
HIDS	Hospital Insurance and Diagnostic Services
HIFU	High Intensity Focused Ultrasound
HIT	Heparin-Induced Thrombocytopenia
HIV	Human Immunodeficiency Virus
HL	Hearing Loss
HLA	Human Leukocyte Antigen
HLA-B27	Human Leukocyte Antigen B27
HMD	Hyaline Membrane Disease
hMG	Human Menopausal Gonadotropin
HMG-CoA	3-Hydroxy-3-Methylglutaryl Coenzyme A
HN	Hydronephrosis
HNPCC	Hereditary Nonpolyposis Colon Cancer
HOCM	Hypertrophic Obstructive Cardiomyopathy
HONK	Hyperosmolar Nonketotic Syndrome
HPA	Hypothalamic-Pituitary-Adrenal
HPF	High-Powered Feld
hPL	Human Prolactin Lactogen
HPI	History of Present Illness
HPO	Hypothalamic-Pituitary-Ovarian
HPV	Human Papillomavirus
HR	Heart Rate
HRCT	High-Resolution Computed tomography
HRT	Hormone Replacement Therapy
HS	Hypernychthemeral Syndrome
HSD	Hydroxysteroid Dehydrogenase
HSG	Hysterosalpingogram
HSIL	High-Grade Squamous Intraepithelial Lesion
HSP	Henoch-Schönlein Purpura

HSV	Herpes Simplex Virus
HTg	Hypertriglyceridemia
HTN	Hypertension
HU	Hounsfield Unit
HUS	Hemolytic Uremic Syndrome
Hx	History
i.e.	That Is
I:G	Insulin to Glucose Ratio
I-123	Iodine-123
IA	Intermittent Auscultation
IABP	Intra-aortic Balloon Pump
IADL	Instrumental Activities of Daily Living
IBD	Inflammatory Bowel Disease
IBS	Irritable Bowel Syndrome
ICA	Intracerebral Artery
ICB	Intracranial Bleed
ICD	Implantable Cardioverter Defibrillator
ICD-10-CM	International Classification of Diseases, Tenth Revision, Clinical Modification
ICF	Intracellular Fluid
ICH	Intracerebral Hemorrhage
ICH	Intracranial Hemorrhage
ICP	Intracranial Pressure
ICSI	Intracytoplasmic Sperm Injection
ICU	Intensive Care Unit
ID	Identification
ID	Infectious Disease
IDDM	Insulin-Dependent Diabetes Mellitus
Ig	Immunoglobin
IgA	Immunoglobulin A
IgE	Immunoglobulin E
IGF-1	Insulin-Like Growth Factor 1
IgG	Immunoglobulin G
IgM	Immunoglobulin M
IGT	Impaired Glucose Tolerance
IHD	Ischemic Heart Disease
IL	Interleukin
IL-4	Interleukin-4
IL-5	Interleukin-5
ILD	Interstitial Lung Disease
IM	Intramuscular
IM	Intermedullary
IMB	Intermenstrual Bleeding
INO	Internuclear Ophthalmoplegia
INR	International Normalized Ratio
INR/PTT	International Normalized Ratio/Partial Prothrombin Time
insp	Inspiratory
insp + exp	Inspiratory plus Expiratory
IO	Inferior Oblique
IOP	Intraocular Pressure
IP	Interphalangeal
IPF	Interstitial Pulmonary Fibrosis
IPF	Idiopathic Pulmonary Fibrosis
IPS	Integrated Prenatal Screening
IPT	Interpersonal Therapy
IQ	Intelligence Quotient
IR	Inferior Rectus
ISBD	International Society for Bipolar Disorders
ISS	Insufficient Sleep Syndrome
IT	Iliotibial

ITP	Idiopathic Thrombocytopenic Purpura
IU	International Units
IUD	Intrauterine Device
IUFD	Intrauterine Fetal Demise
IUGR	Intrauterine Growth Restriction
IUI	Intrauterine Insemination
IV	Intravenous
IVC	Inferior Vena Cava
IVC filter	Inferior Vena Cava Filter
IVDU	Intravenous Drug User
IVF	*In Vitro* Fertilization
IVF	Intravenous Fluid
IVFA	Intravascular Fluorescein Angiography
IVH	Intraventricular Hemorrhage
IVIg	Intravenous Immunoglobulin
IVP	Intravenous Pyelography
Ix	Investigation(s)
JGA	Juxtaglomerular Apparatus
JIA	Juvenile Idiopathic Arthritis
JNC	Joint National Committee
JVD	Jugular Venous Distension
JVP	Jugular Venous Pulse
K^+	Potassium
Kallmann Syndrome	Congenital deficiency of GnRH associated with craniofacial midline defects and/or anosmia
KDOQI	Kidney Disease Outcomes Quality Initiative
kg	Kilogram
KOH	Potassium Hydroxide
KUB	Kidney, Ureters, and Bladder
L	Left
L. pneumophila	*Legionella pneumophila*
L/E	Lower Extremities
LA	Left Atrium
lab	laboratory
LABA	Long-Acting b-Agonist
LAD	Lymphadenopathy
Lat	Lateral
LBBB	Left Bundle Branch Block
LCAT	Lecithin-Cholesterol Acyltransferase
LCL	Lateral Collateral Ligament
LDH	Lactose Dehydrogenase
LDH	Lactate Dehydrogenase
LDL	Low Density Lipoprotein
L-Dopa	Levadopa
LEEP	Loop Electrosurgical Excision Procedure
LES	Lower Esophageal Sphincter
LES	Lambert-Eaton Syndrome
LET	Lidocaine + Epinephrine + Tetracaine
LFT	Liver Function Test
LGA	Large for Gestational Age
LGV	Lymphogranuloma Venereum
LH	Luteinizing Hormone
LLDP	Left Lateral Decubitus Position
LLQ	Left Lower Quadrant
LLSB	Left Lower Sternal Border
LMCC	Licentiate of the Medical Council of Canada
LMN	Lower Motor Neuron
LMP	Last Menstrual Period
LMWH	Low Molecular Weight Heparin
LNG-IUS	Levonorgestrel Intrauterine System
LNMP	Last Normal Menstrual Period

LOC	Loss of Consciousness
LOC	Level of Consciousness
LP	Lumbar Puncture
LPA	Left Pulmonary Arterial
LPD	Luteal Phase Defect
LPS	Lipopolysaccharide
LR	Lateral Rectus
L-R	Left-Right
LRT	Laryngeal Reaction Time
LSD	Lysergic Acid Diethylamide
LSIL	Low-Grade Squamous Intraepithelial Lesion
LT	Leukotrienes
LUQ	Left Upper Quadrant
LUTS	Lower Urinary Tract Symptom
LV	Left Ventricle
LVEDP	Left Ventricular End Diastolic Pressure
LVH	Left Ventricular Hypertrophy
Lytes	Electrolytes
m	Meter
M	Multiparous
M&M	Morbidity and Mortality
M. catarrhalis	*Moraxella catarrhalis*
M. furfur	*Malassezia furfur*
M. genitalium	*Mycoplasma genitalium*
M. hominis	*Mycoplasma hominis*
M. pneumoniae	*Mycoplasma pneumoniae*
M_1	Muscarinic Receptor 1
MAHA	Microangiopathic Hemolytic Anemia
MAOI	Monoamine Oxidase Inhibitor
MAP	Mean Arterial Pressure
MAT	Multifocal Atrial Tachycardia
max	Maximum
Mayer-Rokitansky-Kuster-Hauser Syndrome	Vaginal atresia with variable müllerian duct abnormalities
MB	Myoglobulin
MBP	Major Basic Protein
MCA	Middle Cerebral Artery
MCC	Medical Council of Canada
MCCQE	Medical Council of Canada Qualifying Examination
MCH	Mean Corpuscular Hemoglobin
M-CHAT	Modified Checklist for Autism in Toddlers
MCL	Medial Collateral Ligament
MCP	Metacarpal Phalangeal Joint
MCQ	Multiple Choice Questions
MCV	Mean Corpuscular Volume
MCV	Mean Cell Volume
MD	Medical Doctor
MDAC	Multidose Activated Charcoal
MDD	Major Depressive Disorder
MDE	Major Depressive Episode
MDI	Metered Dose Inhaler
MDMA	3,4-Methylenedioxymethamphetamine
MDRD	Modification of Diet in Renal Disease
ME	Metaphysis + Epiphysis
med	Medical
meds	Medication
MEN-1	Multiple Endocrine Neoplasia Type 1
Men-C	Meningococcal C Conjugate
MetSyn	Metabolic Syndrome
Mg^{2+}	Magnesium
MG	Monoglyceride

MG	Myasthenia Gravis
MGUS	Monoclonal Gammopathy of Uncertain Significance
MH	Malignant Hyperthermia
MHA-TP	Microhemagglutination for Treponema Pallidum
MI	Myocardial Infarction
mL	Milliliter
MM	Multiple Myeloma
mm Hg	Millimeters Mercury
MMR	Measles, Mumps, Rubella
MMSE	Mini Mental Status Exam
mo	Month
MOD	Myocardial Oxygen Demand
MOM	Milk of Magnesia
MONA	Morphine, O_2, Nitroglycerine, Aspirin
MP	Metacarpophalangeal
MPA	Medroxyprogesterone Acetate
MPGN	Membranoproliferative Glomerulonephritis
MPSS	Methylprednisolone Sodium Succinate
MR	Mitral Regurgitation
MR	Medial Rectus
MR	Magnetic Resonance
MRA	Magnetic Resonance Angiography
MRCP	Magnetic Resonance Cholangiopancreatography
MRI	Magnetic Resonance Imaging
mRNA	Messenger Ribonucleic Acid
MRV	Magnetic Resonance Venography
MS	Mitral Stenosis
MS	Multiple Sclerosis
MSAFP	Maternal Serum AFP
MSDS	Material Safety Data Sheet
MSE	Medical Supplies and Equipment
MSG	Monosodium Glutamate
MSH	Melanocyte-Stimulating Hormone
MSK	Musculoskeletal
MSS	Maternal Serum Screen
MTP	Metatarsal phalangeal
MTX	Methotrexate
Musc	Muscle
MVC	Motor Vehicle Collision
Mx	Management
N	Nulliparous
N	No
N. gonorrhoeae	*Neisseria gonorrhoeae*
N. meningitides	*Neisseria meningitides*
n/a	Not Applicable
N/S	Normal Saline
N/V	Nausea and Vomiting
NA	Nasogastric Aspiration
Na^+	Sodium
NAAT	Nucleic Acid Amplification Test
NAC	*N*-acetylcysteine
NACI	National Advisory Committee on Immunization
NaOH	Sodium Hydroxide
NASCIS	National Acute Spinal Cord Injury Study
NASH	Nonalcoholic Steatotic Hepatitis
NCS	Nerve Conduction Study
NE	Norepinephrine
NEC	Necrotizing Enterocolitis
NG	Nasogastric
NGT	Nasogastric Tube
NICU	Neonatal Intensive Care Unit

NJ	Nasojejunal
NKF	National Kidney Foundation
NKH	Nonketotic Hyperglycemia
NMJ	Neuromuscular Junction
NMS	Neuroleptic Malignant Syndrome
NO	Nitric Oxide
No.	Number of
NPJT	Nonparoxysmal Junctional Tachycardia
NPO	Nothing by Mouth
NSAID	Nonsteroidal Anti-inflammatory Drug
NSCLC	Non-small-Cell Lung Cancer
NSERC	Natural Sciences and Engineering Research Council
NST	Nonstress Test
NSTEMI	Non-ST Elevation Myocardial Infarction
NSx	Neurosurgery
NT	Neurotransmitter
NTD	Neural Tube Defects
NTHI	Nontypable *Haemophilus influenzae*
NTUS	Nuchal Translucency Ultrasound
O&P	Ova and Parasites
O/E	On Exam
O_2	Oxygen
OA	Osteoarthritis
OA	Occiput Anterior
OB/GYN	Obstetrician/Gynecologist
OC	Obsessive Compulsive
occ. lobe	Occipital Lobe
OCD	Obsessive Compulsive Disorder
OCP	Oral Contraceptive Pills
OD	Overdose
ODP	Opponens Digiti Minimi
OG	Osmolar Gap
OG	Orogastric
OGL	Orogastric Lavage
OGTT	Oral Glucose Tolerance Test
OHP	Hydroxyprogesterone
OHS	Occupational Health and Safety
OP	Occiput Posterior
OP	Opponens Pollicis
Op	Operative
OR	Operating Room
ORIF	Open Reduction Internal Fixation
ORS	Oral Rehydration Solution
os	Ostium of Uterus
OSA	Obstructive Sleep Apnea
Osm	Osmolality
OT	Occupational Therapy
OT	Occiput Transverse
OTC	Over the Counter
P	Progesterone
P	Progestin
p.v.	Per Vagina
PA	Posterior-Anterior
$Paco_2$	Arterial Pressure of Carbon Dioxide
pANCA	Perinuclear Antineutrophil cytoplasmic antibody
P-ANCA	Perinuclear Antineutrophil cytoplasmic antibodies
Pao_2	Partial Pressure of Oxygen in Arterial Blood
Pao_2	Alveolar Oxygen Tension
Pao_2/Fio_2	Partial Pressure of O_2 in Arterial Blood to Fractional Content of Inspired O_2 Ratio
Pap	Papanicolaou

PAPP-A	Pregnancy-Associated Plasma Protein-A
PBC	Primary Biliary Cirrhosis
PCA	Posterior Cerebral Artery
PCI	Percutaneous Coronary Intervention
PCL	Posterior Cruciate Ligament
Pco_2	Partial Pressure of Carbon Dioxide
PCOS	Polycystic Ovary Syndrome
PCP	Phencyclidine
PCR	Polymerase Chain Reaction
PCT	Proximal Convoluted Tubule
PCWP	Pulmonary Capillary Wedge Pressure
PD	Peritoneal Dialysis
PD	Personality Disorder
PDA	Patent Ductus Arteriosus
PDE-5	Phosphodiesterase-5
PE	Pulmonary Embolism
PEEP	Positive End Expiratory Pressure
PEG	Polyethylene Glycol
PEx	Physical Examination
PF	Peak Fow
PFO	Patent Foramen Ovale
PFT	Pulmonary Function Test
PG	Prostaglandin
PGE_1	Prostaglandin E_1
PGE_2	Prostaglandin E_2
PGF	Placental Growth Factor
PGME	Postgraduate Medical Education
pH	Hydrogen Potential (measure of acidity of solution)
PHAC	Public Health Agency of Canada
Phos.	Phosphorus
PID	Pelvic Inflammatory Disease
PIH	Pregnancy-Induced Hypertension
PIP	Proximal Interphalangeal Joint
PKD	Polycystic Kidney Disease
PKU	Phenylketonuria
PL	Palmaris Longus
Pl	Pleural
PLM	Periodic Limb Movement
Plt	Platelet
PM	Polymyositis
PMDD	Premenstrual Dysmorphic Disorder
PMHx	Past Medical History
PMI	Point of Maximal Impulse
PMN	Polymorphonuclear Leukocytes
PMNLs	Polymorphonuclear Leukocytes
PMPRB	Patented Medicines Price Review Board
PMR	Polymyalgia Rheumatica
PMS	Premenstrual Syndrome
PNa	Plasma Sodium Concentration
PND	Paroxysmal nocturnal dyspnea
Pneu-C	Pneumococcal Conjugate
PNS	Peripheral Nervous System
PO	Per Os
PO	By Mouth
Po_2	Partial Pressure of Oxygen
PO_4	Phosphate
POF	Premature Ovarian Failure
POGG	Peace, Order, and Good Governance
POMC	Proopiomelanocortin
POPQ	Pelvic organ prolapse quantification
Posm	Plasma Osmolality

PP	Prone positioning
PPD	Purified Protein Derivative Test/Mantoux Test
PPG	Postprandial Glucose
PPH	Postpartum Hemorrhage
PPHN	Persistent Pulmonary Hypertension
PPI	Proton Pump Inhibitor
PPROM	Prolonged Premature Rupture of Membranes
PPV	Positive Predictive Value
PR	Pulmonic Regurgitation
PR	Per Rectum
PRAM	Pediatric Respiratory Assessment Measure
PRBC	Packed Red Blood Cell
Prep	Preparation
Prev.	Previous
PRL	Prolactin
prn	As Needed
PROM	Premature Rupture of Membranes
PS	Pulmonary Stenosis
PsA	Psoriatic Arthritis
PSA	Prostate-Specific Antigen
PSC	Primary Sclerosing Cholangitis
Psych Hx	Psychiatric History
PT	Physical Therapy
PT	Prothrombin Time
pt	Patient
PTH	Parathyroid Hormone
PTHrP	Parathyroid Hormone–Related Peptide
PTL	Preterm Labor
PTSD	Posttraumatic Stress Disorder
PTT	Partial Thromboplastin time
PTX	Pneumothorax
PUD	Peptic Ulcer Disease
PulmHTN	Pulmonary Hypertension
P_{urea}	Plasma Urea
PUV	Posterior Urethral Valve
PUVA	Psoralen Ultraviolet A
PV	Pulmonary Ventricle
PVC	Premature Ventricular Complex
PVD	Peripheral Vascular Disease
PVR	Peripheral Vascular Resistance
PVR	Postvoid Residual
PWI	Perfusion Weighted Imaging
Px	Physical Exam
PYLL	Potential Years Life Lost
P-Σ	Parasympathetic Nervous System
q	Every (dose related)
q.d.	Every Day (dose related)
q.i.d.	Four Times a Day
QBHCG	Quantitative b-HCG
QT	QT Interval
R	Right
R&M	Routine and Microscopy
R/O	Rule Out
RA	Rheumatoid Arthritis
RA	Right Atrium
RADT	Rapid Antigen Detection Test
RAI	Radioactive Iodine
RAPD	Relative Afferent Pupillary Defect
RAS	Renin Angiotensin System
RAS	Renal Artery Stenosis
RBBB	Right Bundle Branch Block

RBC	Red Blood Cell
RCC	Renal Cell Carcinoma
RCM	Radiocontrast Media
RCMP	Royal Canadian Mounted Police
RCPSC	Royal College of Physicians and Surgeons of Canada
RCT	Randomized Control Trial
RDS	Respiratory Distress Syndrome
RDW	Red Blood Cell Distribution Width
ReA	Reactive Arthritis
REB	Research Ethics Board
rehab	Rehabilitation
Resp	Respiratory
RF	Rheumatoid Factor
RF	Risk Factor
RF	Renal Failure
RFT	Renal Function Test
RHA	Regional Health Authority
RhIg	Rh Immunoglobulin
RI	Respiratory Infection
RICE	Rest, Ice, Compression, and Elevation
RL	Ringer Lactate
RLQ	Right Lower Quadrant
RLS	Restless Leg Syndrome
ROH	Alcohol
ROM	Range of Motion
ROM	Rupture of Membranes
ROP	Retinopathy of Prematurity
RORX	Radiation Therapy
ROS	Review of Symptoms
RPA	Retropharyngeal Abscess
RPE	Retinal Pigment Epithelium
RPLND	Retroperitoneal Lymph Node Dissection
RPR	Rapid Plasma Reagin
RR	Respiratory Rate
RSV	Respiratory Syncytial Virus
RT	Radiotherapy
RTA	Renal Tubular Acidosis
RTI	Respiratory Tract Infection
RUQ	Right Upper Quadrant
RV	Residual Volume
RV	Right Ventricle
Rx	Treatment
Rx	Therapy
RXN	Reaction
sec	Seconds
S	Superficial
S&Sx	Signs and Symptoms
S. Aureus	*Staphylococcal aureus*
S. pneumoniae	*Streptococcus pneumoniae*
S. viridans	*Staphylococcus viridans*
S/E	Side effects
SA	Sinoatrial
SABA	Short-Acting b-Agonist
SABD	Short-Acting Bronchodilator
SAH	Subarachnoid Hemorrhage
SANRT	Sinoatrial Node Reentrant Tachycardia
SBE	Subacute Bacterial Endocarditis
SBP	Systolic Blood Pressure
sc	Subcutaneous
SC	Sternoclavicular
SCC	Squamous Cell Carcinoma

SCFE	Slipped Capital Femoral Epiphysis
SCH	Subconjunctival Hemorrhage
SCI	Spinal Cord Injury
Scl-70	Scleroderma-70
SCLC	Small Cell Lung Cancer
SD	Standard Deviation
SDH	Subdural Hematoma
SDM	Substitute Decision Maker
SE	South East
SE	Status Epilepticus
SERM	Selective Estrogen Receptor Modulator
SFH	Symphysis Fundus Height
SGA	Small for Gestational Age
SGLT1	Sodium-Dependent Glucose Transporter 1
SHx	Social History
SI	Stress Incontinence
SI	Sacroiliac
SIADH	Syndrome of Inappropriate Antidiuretic Hormone
SIDS	Sudden Infant Death Syndrome
SIRS	Systemic Inflammatory Response Syndrome
SJS	Stevens-Johnson Syndrome
SLAP	Superior Labral Anterior-Posterior
SLE	Systemic Lupus Erythematosus
SLP	Speech Language Pathology
SMX	Sulfmethoxide
SNB	Sentinel Node Biopsy
SNc	Substantia Nigra Pars Compacta
SNHL	Sensorineural Hearing Loss
SNr	Substantia Nigra Pars Reticulata
SNRI	Serotonin-Norepinephrine Reuptake Inhibitor
SNS	Sympathetic Nervous System
SO	Salpingo-oophorectomy
SO	Superior Oblique
SOB	Short/Shortness of Breath
SOGC	Society of Obstetricians and Gynecologists of Canada
SOI	Syrup of Ipecac
SPEP	Serum Protein Electrophoresis
spp.	Species
SR	Superior Rectus
SS	Symptom Severity
SSA	Sulfosalicylic Acid
SSHRC	Social Sciences and Humanities Research Council
SSRI	Selective Serotonin Reuptake Inhibitor 1
Staph epidermidis	*Staphylococcus epidermidis*
STEMI	ST Elevation Myocardial Infarction
STI	Sexually Transmitted Infection
STN	Subthalamic Nucleus
Strep. pneumo	*Streptococcus pneumonia*
Strep. pyogenes	*Streptococcus pyogenes*
SV	Stroke Volume
SV	Supraventricular
SVC	Superior Vena Cava
SVD	Spontaneous Vaginal Delivery
sVEGFR-1	Soluble Vascular Endothelial Growth Factor Receptor 1
SVR	Systemic Vascular Resistance
SVT	Supraventricular Tachycardia
SW	Social Work
SWU	Septic Work Up
Swyer Syndrome	46XY gonadal dysgenesis

Sx	Symptom
Syst.	Systolic
T	Testosterone
T	Temperature
T&X	Type and cross match
T. mentagrophytes	*Trichophyton mentagrophytes*
T. pallidum	*Treponema pallidum*
T. rubrum	*Trichophyton rubrum*
T. vaginalis	*Trichomonas vaginalis*
t.i.d.	Three Times a Day
T_3	Triiodothyronine
T_4	Tetraiodothyronine
T_4	Thyroxine
TA	Temporal Artery
TAb	Thyroid Autoantibodies
Tab	Tablet
TAL	Thick Ascending Limb of the Loop of Henle
TAPVD	Total Anomalous Pulmonary Venous Drainage
TB	Tuberculosis
TBI	Traumatic Brain Injury
TBSA	Total Body Surface Area
TBV	Total Blood Volume
TBW	Total Body Water
TC	Total Cholesterol
TCA	Tricyclic Antidepressant
TcB	Transcutaneous Bilirubinometry
TCC	Transitional Cell Carcinoma
Td	Tetanus
TD	Transdermal
TD	Tardive Dyskinesia
TEE	Transesophageal Echocardiogram
TEF	Tracheoesophageal Fistula
TENS	Transcutaneous Electrical Nerve Stimulation
TET	Tubal Embryo Transfer
TG	Triglyceride
TGA	Transposition of Great Arteries
TH	Thyroid Hormone
TIA	Transient Ischemic Attack
TIBC	Total Iron Binding Capacity
TIG	Tetanus Immunoglobulin
TIMI	Thrombolysis in Myocardial Infarction
TIPS	Transjugular Intrahepatic Portosystemic Shunt
TLC	Total Lung Capacity
TMJ	Temporal Mandibular Joint
TMP	Trimethoprim
TMP-SMX	Trimethoprim and Sulfamethoxazole
Tn	Troponin
TNF	Tumor Necrosis Factor
TNF-α	Tumor Necrosis Factor Alpha
TNM	Tumor size, Node involvement, Metastatic spread
TNMS	Tumor Nodes Metastasis Staging
TOF	Tetralogy of Fallot
tox	Toxin
tPA	Tissue Plasminogen Activator
TPN	Total Parenteral Nutrition
TP-PA	Treponema Pallidum Particle Agglutination
TPR	Total Peripheral Resistance
TR	Tricuspid Regurgitation
TRH	Thyrotropin-Releasing Hormone
TRS	TIMI Risk Score
TRUS	Transrectal Ultrasound

TS	Tricuspid Stenosis
TSB	Total Serum Bilirubin
TSH	Thyroid-Stimulating Hormone
TSS	Toxic Shock Syndrome
TT	Thrombin Time
TTD	Teletype/Telecommunications Devices
TTE	Transthoracic Echocardiogram
TTKG	Transtubular Potassium Gradient
TTN	Transient Tachypnea of Newborn
TTNB	Transthoracic Needle Biopsy
TTP	Thrombotic Thrombocytopenic Purpura
TURP	Transurethral Resection of the Prostate
TVR	Target Vessel Revascularization
TVS	Transvaginal Sonography
TVUS	Transvaginal Ultrasound
Tx	Management
TXA2	Thromboxane A2
U/A	Urinalysis
U/E	Upper Extremities
U/O	Urine Output
U/S	Ultrasound
UA	Unstable Angina
UA	Uric Acid
UC	Ulcerative Colitis
UDP	Uridine Diphosphate
UDP-GT	Uridine Diphosphate Glucuronyl Transferase
UFH	Unfractionated Heparin
UGI	Upper Gastrointestinal
UI	Urinary Incontinence
UIP	Usual Interstitial Pneumonitis
UMN	Upper Motor Neuron
Uosm	Urine Osmolality
UPEP	Urine Protein Electrophoresis
UPJ	Ureteropyelic Junction
URTI	Upper Respiratory Tract Infection
USPSTF	U.S. Preventive Services Task Force
UTI	Urinary Tract Infection
UV	Ultraviolet
UVB	Ultraviolet B
V. cholera	*Vibrio cholera*
V/Q scan	Ventilation Perfusion Scan
Var	Varicella
vb insuff	Vertebro-basilar Insufficiency
VC	Vital Capacity
VCD	Vocal Cord Dysfunction
VCUG	Voiding Cystourethrogram
VDRL	Venereal Disease Research Laboratory Test (for syphilis)
VEGF	Vascular Endothelial Growth Factor
VFib	Ventricular Fibrillation
VIP	Vasoactive Intestinal Peptide
Vit	Vitamin
Vit B_{12}	Vitamin B_{12}
VLDL	Very Low Density Lipoprotein
VMA	Vanillylmandelic Acid
VSD	Ventricular Septal Defect
VT	Ventricular Tachycardia
VTE	Venous Thromboembolism
VUJ	Vesicoureteral Junction
VUR	Vesicoureteral Reflux
vWD	von Willebrand Disease

VZIG	Varicella Zoster Immunoglobulin
VZV	Varicella Zoster Virus
w/u	Work-up
WBC	White Blood Cell Count
WBI	Whole Bowel Irrigation
WCB	Workers Compensation Board
WHI	Women's Health Initiative
WHIMS	Women's Health Initiative Memory Study
WHO	World Health Organization
wk	Week
WPI	Widespread Pain Index
Wt	Weight
XR	X-ray
Y	Yes
y.o.	Year Old
yr	Year
ZIFT	Zygote Intrafallopian Transfer
β	Beta
Σ	Sympathetic Nervous System

APPENDIX

C

Objectives for the Qualifying Examination Index

Health Advocate

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Collaborator

Collaborator (Chapter 2)

Communicator

Communicator (Chapter 2)

Leader (formerly Manager)

Leader (Chapter 2)

Professional

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Scholar

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